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RECORDS of RESEARCHES

in the

FACULTY of AGRICULTURE
UNIVERSITY of TOKYO

No. VII (1956-1957)

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I. Agriculture

Abstract Nos. 1—17

1. The action of a synthetic phytohormone 2, 3, 6-trichlorobenzoic acid. Yakichi NOGUCHI (Kagaku 27, 209–10, 1957)

Several years ago, Dr. ZIMMERMAN reported to the author that it would be interesting to test the effect of a synthetic phytohormone 2,3,6-trichlorobenzoic acid (TCBA) in comparison with that of 2,3,5-triiodobenzoic acid (TIBA) which was known to have such special effects on the plant such as suppressing vegetative growth and promoting flower development. This experiment was carried out according to the suggestion above mentioned.

On the 13th of July, 1956, the water solution of TCBA (concentrations: 0.0005%, 0.005% and 0.05%) was sprayed on the seedlings of tomatoes, 10 cm. in height with 6 leaves. The first sign of reaction was seen 18 hours later on the treated plants. Stem bending and epinasty of leaves progressed on and on, especially in the younger portion of plants. The more TCBA was contained in the solution used, the clearer were these modifications of plants. The leaves, showing dark color and abnormal growth in thickness, curled from their margin. A large number of young roots began to appear near the base of the stem. These reactions are similar to those which were observed on plants after treatment with TIBA except the last point.

Soon within two weeks, however, there appeared different phases of growth according to the concentration of TCBA used. When the plants had been treated with a solution of higher concentration, i.e. 0.05%, the growth of stems stopped and flower buds developed simultaneously; a characteristic effect induced by TCBA. On the other hand, the solution of lower concentration, both 0.005% and 0.0005%, gave an effect just like that of auxin and promoted the elongation of stems. Consequently, the author supposed that TCBA might have the action of both TCBA and auxin.

2. Cultivation of the steam tips of some cultivated plants in vitro. Shin-ichiro KAWATA (Proc. Crop Sci. Japan. 25, 173–174, 1957)

Since 1952, in our laboratory, culturing of the stem tips of some cultivated plants has been carried out so as to understand the physiological mechanism of their flower bud initiation and recently the author succeeded in the flowering of rice and wheat plants.

The plants used in this experiment are as follows: *Glycine max* Mer.; *Phaseolus vulgaris* L.; *Helianthus tuberosus* L.; *Ipomoea Batatas* Lam.; *Xanthium Stramarium* L.; *Helianthus annuus* L.; *Rubus hirstus* Thunb.; *Solanum tuberosum* L.; *Lycoperiscum esculentum* Mill.. *Dioscorea japonica* Thunb.; *Cucurbita pepo* L.; *Cosmos bipinnutus* Cav.; *Callistephus chinensis* Ness.; *Hydrangea Hortensis* DC.; *Zea Mays* L.; *Asparagus officinalis* L.; *Oryza sativa* L.; *Triticum vulgare* Vill.; *Purunus Yedonensis* Matsum.; *Rhododendron serhyllifolium* Mi.; *Morus alba* L. and *Purunus serotina* Rehd.

The stem tips were cut from the seedlings or plants under sterile condition and transplanted to tubes which contained the following medium; the composition of mineral salts in the nutrient solution was essentially the same as that used by WHITE and BONNER. The stem tips of *Asparagus officinalis* L.; *Cosmos bipinnutus* Cav.; *Rubus hirstus* Thunb. and *Glycine max* Mer. developed during a period from one to five months without flower bud initiation. Especially the stem tips of rice and wheat plants developed and produced the plantlets which consisted of stems and leaves and adventitious roots. About 80 days after the first transplanting, the plantlets of them showed the heading and bloomed without fruiting.

3. Studies on the vitamin C in field and garden crops. Tomota SUGAWARA (Rpt. Inst. Agronomy, Fac. Agr., Univ. Tokyo, pp. 1–82, 1957)

The present experiments were undertaken to prove the effect of environmental factors on the formation of ascorbic acid in plants, relation among the formation of ascorbic acid, development of chlorophyll and beginning of photosynthesis, mechanism for the formation of ascorbic acid, and the amount of ascorbic acid in fruits and vegetables. The results are summarized as follows:—

Light is a factor which seems to influence the ascorbic acid content of fruits and leafy tissues of plants consistently. The ascorbic acid content of spinach decreased by about 30 per cent, when the light intensity was decreased by about 40 per cent. Similar result was observed in fruits. A single apple fruit is green on one side (shady side) and red on the other side (sunny side). The ascorbic acid content of the sunny side exceeded that of the shady side in 20 pairs of analysis.

The ascorbic acid content of the spinach largely depended on the amount of fertilizers in the soil. Larger amount of nitrogen result in greater ascorbic acid content, and these contents were markedly low in the leaves of the nitrogen-deficient plants. The effect of foliage application of urea on the ascorbic acid content of spinach and lettuce was consistent. Application of urea resulted in higher ascorbic acid values. The effect of phosphorous and potassium in the ascorbic acid content was much smaller than that of nitrogen. The influence of the amount nitrogen, phosphorous and potassium on the ascorbic acid content of potatoes was inconsistent. Heavy application of nitrogen resulted in slightly lower ascorbic acid values. High level of potassium, however, gave higher concentration of ascorbic acid.

Chlorophyll b is not essential for the initation of photosynthesis and the formation of ascorbic acid, although chlorophyll b is, without exception, contained in the leaves of normal green land plants. From the results of these experiments, it may certainly be stated that the formation of ascorbic acid has a close connection with the initiation of photosynthesis, but has no direct connection with the appearance of chlorophll b.

The ascorbic acid is structurally related to hexose, and one method of chemical synthesis, by which glucose may be converted to ascorbic acid, is represented by the following series of reaction: d-glucose d-sorbitol l-sorbose l-xylo-2-keto hexonic acid-ascorbic acid. The hypothesis propounded for its biological synthesis have generally assumed some hexose or others to be the starting material or perhaps the immediate precursor. As a paradigm for such a process the chemical synthesis from d-glucose may be useful.

There is a definite increase in the ascorbic acid content of spinach plants as

they grow. There is a marked loss in ascorbic acid in spinach after they have attained maximum growth. This loss of ascorbic acid is a factor which should be taken into consideration when spinach is grown for food. Tomatoes increase some what in ascorbic acid content as the fruit ripens. However, mature green tomatoes may have nearly the same value as the red ripe fruit. The ascorbic acid content of strawberries increase considerably on reddening. Broad bean and green peas, however, show a maximum ascorbic acid content during the tender stage, and the content decreases as the seed matures. This is consistent with the lack of ascorbic acid in non-respiring mature seeds.

4. Morphorocial and physiological studies on nodule formation in soybeans. Part 2. Relations between the foriar application of carbohydrates and nodule formation. Etuo KAMATA (Proc. Crop Sci. Soc. Japan **26**, 58–60, 1957)

In the previous paper, the author was led to conclude that the nodule formation in soybean plants was controlled by the level of the reducing sugar content in the host tissues, by the result that a high nitrogen level in tissues or in soils on which the plants grew, had no effect on the penetration of *Rhizobium japonicum* into the roots and that the mere fact that the roots contained nitrogen, the less they had sugars in their tissues.

New experiments were carried out in order to prove the above mentioned conclusion by controlling artificially the sugar level of the host tissues, the nitrogen content of which was very high, with foliar application of carbohydrates. Supplies of D-Glucose, D-Fructose, D-Xylose and Sucrose promoted the formation of nodules on the plants even when they ewre grown under rich nitrogen conditions, or also when grown by sand culture, deficient in nitrogen, the plants being actually rich in the element even in the latter case. Of course, these sugars, enough for giving such effects, are usually contained in soybeans by nature.

5. Physiological studies on the vernalization of wheat plants. Part. 1. The retention of vernalized condition in excised stem tips. Aiya ISHIHARA (Pro. Crop Sci. Soc. Japan **26**, 20–23, 1957)

Two varieties of winter wheat and one variety of spring wheat were use as materials in these experiments. The plants were grown in winter, both in the field under the condition of natural low temperature, and in a greenhouse kept at relatively high temperature. In this way, the plants in various states of vernalization were obtained.

Excised stem tips of these plants were cultured in vitro for more than two months under the condition of high temperature combined with continuous illumination by artificial light sources, which might be considered not to affect the progress of vernalization and to be rather favorable for the spike formation in the plantlets in the culture.

From the results of these cultures, it was found that the excised stem tips of vernalized plants developed into plantlets on which spikes were formed, while those of unvernalized plants grew up to plantlets only remaining in a vegetative stage. So it was necessarily concluded that the vernalized condition in wheat plants is retained in their excised stem tips, the fact probably showing that some qualitative changes take place in the apical meristem in the course of vernalization.

6. Studies on CO_2 exchange in crop plants. Part 5. A newly devised "Infrared CO_2-Analyser", and some of the results obtained by it, comparing the diurnal changes in photosynthetic rate in rice plants under an isolated condition with that under a community condition. Yoshiji TOGARI, Tomoshiro TAKEDA and Hiroshi MARUTA (Proc. Crop. Sci. Soc. Japan **24,** 254-259, 1956)

In connection with researches of physiology and ecology of crop plants, methods especially effectual for instantaneous and successive analysis of gas exchanged by growing plants have long been wanted by many investigators. Most of the devices hitherto known are more or less inaccurate and tedious though designed ingeniously, and are not satisfactory for general use in such researches.

In the present report a negative type "Infrared gas analyser" newly devised by the authors is described.

Infrared radiation, sent from a light source, enters into the absorption cell, and is partially absorbed by H_2O, CO_2 and other gases contained in sample air in the cell, respectively. Then, the ray enters into the negative filter, consisting of two chambers, one containing 100% CO_2 gas and the other N_2 gas. The part of the ray passing through the former is strongly absorbed at that region, while the part passing through N_2 gas in the latter chamber is not absorbed here at all. Each of the two parts of the ray falls finally on each junction D_1 and D_2, respectively, of the thermal detector, a thermopyle of differential type. The potential difference between the amount of energy absorption by 100% CO_2 gas and that by the sample air is measured. The larger the concentration of CO_2 gas in the sample air, the smaller becomes the difference measured, no other gases than CO_2 intertering with the measurement.

The sample air is sucked by a pump alternatively through either of the three ways, one for a blank test and the others for two replicated measurements of the air from the assimilation chamber, being turned from one to another by a gas switch which is operated electromagnetically and synchronized with the automatic allocation of the marking pen of a triple-ways recording voltmeter.

Several examples of the results obtained by the apparatus concerning the diurnal changes in photosynthetic activity of rice plants growing isolated in a pot and of those growing in community are presented.

Part 6. The effect of light intensity and spacing on the photosynthetic rate of rice plant in community conditions. Tomoshiro TAKEDA and Hiroshi MARUTA (Proc. Crop. Sci. Soc. Japan **24,** 331-338, 1956)

In the 2nd report the authors have discussed that the rice plant cultured in pot, i. e. in the isolated condition, has different demands for light in order to have its maximum photosynthetic capacity according to its different growing stages. This difference in demand for light is due to the differences in the condition of receiving the light, which is influenced by the mutual shading rate of leaves within the individual plant. It is quite clear that the ecological conditions of the pot-cultured plant is remarkably different from that of the plant in community. In general, the rice plants are cultured in community conditions in the paddy field, therefore, in order to approach the practical problems of rice cultivation, studies of the photosynthesis

of rice plants must be done in community conditions. In this paper the authors have tried to understand the relationships between the spacing of plants and the demands for light by the plant. The effect of light intensity on the photosynthetic rate of plant, cultured in community conditions at different spacings, was measured by the "Infrared gas analyser" described in the previous paper.

The results obtained are as follows:

1. In community conditions, at the early stage of growth the demand for light by the rice plant for its maximum photosynthetic rate are comparatively low, and the saturation point lies under about 50 k Lux, and then the demand for light by the plant increases gradually according to the growing stage, after middle stage of growth (about full tiller stage) the light saturation phenomenon under full sunlight is extinguished, and the transition from light-saturation to -unsaturation is influenced by the spacing of the plants. The thicker the spacing of the plants, the earlier the extinction of the light-saturation phenomenon. After the extinction of the light-saturation phenomenon, the relationships of photosynthesis to light intensity becomes linear gradually, and this is due to the differences in the condition of receiving the light, which is greatly influenced by the mutual shade among the plants.

2. Changes in the photosynthetic rate of rice plant in community are remarkably influenced by the growing stage and also by the spacing of the plants. In thin spacing (36×36 cm^2) and intermediate spacing (22×24 cm^2), the maximum photosynthetic rate is observed at the stage when the most active tillering takes place, then it decreases gradually until the booting stage, and after heading time it decreases remarkably. On the other hand, the thick spacing (12×12 cm^2) shows its maximum photosynthetic rate from full tiller stage to booting stage, and after heading time it decreases gradually. The differences in the changes in photosynthetic rate due to the spacing of the plants may be supposed to be caused by the differences in the interrelationships between the top-growth and the uptake abilities of the fertilizer due to the differences in the conditions of receiving the light, which is greatly influenced by the spacing of the plants.

7. Studies on the production and behavior of carbohydrates in rice plant. Part 3. Influence of environmental conditions on the accumulation of carbohydrates. Atsuhiko KUMURA (Proc. Crop. Sci. Soc. Japan **24**, 324–330, 1956)

Rice plants, the variety Nōrin No. 29, were grown in pots under various environmental conditions and several aspects concerning their carbohydrate accumulation were observed. The results may be summerized as follows:

At higher levels of N nutrition, the amount of carbohydrates accumulated in the plant at its maturation period was found to be large and the proportion of the amount of accumulation during the later period of growth to the total for the whole period was high, in comparison to that in the plant grown at lower levels of N. In the latter cases, the rate of carbohydrate accumulation was found to be accelerated by supplying N in the ripening period, in contrast with the former cases where the plants had previousy been grown at higher levels of N, the acceleration being less distinct.

The plants grown at lower levels of P nutrition accumulated smaller amounts of carbohydrate than that by the plants grown at higher P levels, but the rate of accumulation in the former plants were accelarated by application of P in its ripening period.

The plants grown under low intensity of light (shaded by cloth) showed many characteristics similar to those in the plants grown with high levels of N nutrition, and the dry weight of the plant and the absolute amount of accumulated carbohydrates in it were found to be smaller than those in the plant grown under a natural light condition.

At the period of maturation, it was found that about 90-95% of accumulated carbohydrates were distributed in the panicles, while only a small part of them was distributed in the vegetative organs under the ordinary contition. Under the contition where the photosynthetic activities of leaves were extremely vigorous, a large amount of surplus carbohydrates, being unable to move into the panicles because of exceeding the receiving capacity for storage of the substance, remained in the vegetative organs, particularly in the culms.

Part 4. Studies on the physiological characteristics of the developmental stages of rice plant by means of photoperiodic treatment. Atsuhiko KUMURA (Proc. Crop. Sci. Soc. Japan **25**, 122–123, 1956)

Rice plants, var. Nōrin No. 29, were pot cultured under various photoperiodic conditions, namely: natural day-length (N), short day (S), long day (L), 10 short days and thereafter long day $(S\text{-}L)_1$, and short day up to heading and thereafter long day $(S\text{-}L)_2$.

The plants treated entered into the reproductive phase at different times and the stage proceeded at different paces according to the condition. By means of comparing these plants with reference to dry weight and contents of chemical constituents, physiological characteristics of each stage of development were examined.

In the early stage of reproductive phase the plants seemed to behave just as the plant in vegetative phase in reference to dry matter production, nitrogen absorption and content of each chemical constituents (crude protein, sugar, starch, hemicellulose and cellulose) in spite of obvious difference in morphological aspects.

In accordance with panicle development, sugar and starch accumulation gradually replaced the production of skeleton constituents (hemicellulose, cellulose), and in ripening period, starch accumulation predominated over the production of any other constituents and productivity of dry matter and absorbability of nitrogen declined.

8. The biological action of x-ray on the rice plants of the different seed-grown origins. Hikoyuki YAMAGUCHI (Japanese Journ. Breed. **6**, 91–95, 1956)

The experiment was conducted in order to clarify the relationship between the property of the seed materials in rice plants and their susceptibility to x-radiation. Dormant seeds of each seed-grown origin, at where rice plants from the same sources were cultivated during a period of three years, were treated with 13,000 r. of x-ray.

The differences of susceptibility to x-ray were observed on germinability, inhibition of seedling growth, number of mature plants and spike sterility of the treated generation in a variety, "Kairyo Aikoku". But in the case of "Norin No. 1", this difference was only observed on the germinability. The deviation of the sensitivity to x-radiation within a variety is probably due to secondary property of the physiological conditions rather than the primary effect of seed size. Various chlorophyll deficient mutants were produced in the second generation. Also, in this experiment, intervarietal difference was given; that is, the higher frequency of chlorophyll destroying mutation in a variety "Kairyo Aikoku" was found in comparison with another variety "Norin No. 1".

9. Studies on the inheritance of flower types in Cosmos bipinnatus CAV. (Preliminary Report). Yoshihiko SAMATA (Japanese Journ. Breed. **6**, 142–146, 1956)

(1) The flower types found in *Cosmos bipinnatus* CAV. can be classified into the following four main groups: single-flowered types, double-flowered types, malform-flowered types and malform-doube mixed types.

(2) The single-flowered type, when inbred, does not segregate any of the other types.

(3) The non-petalous type (np type), when inbred, always produces the non-petalous only, while the other malform-flowered or the double-flowered, when inbred or crossed to one another, segregate into all types, including single, double and malform-flowered types.

(4) The crossing of the non-petalous to the normal single-flowered, produces every kind of flower types in the F_2 generation, which means that the non-petalous, involves the factors for doubleness or malformity. Many slightly-doubled plants appear in the F_2 generation, which segregate a few highly-doubled plants in the following generation.

(5) According to the facts mentioned above it seems that doubleness and malformity are in some cases genetically closely connected with each other, but whether the relation between the two is originated from the mutability of one gene or from multiple genes or from the presence of some modifiers have not yet been fully clarified.

(6) Remarkable shortening of the ray petals is observed in the F_1 of the cross of non-petalous type to single-flowered type.

10. Studies on the mechanism and genetical behaviour of the stiffness in the husking of the naked barley. Kinya KUSHIBUCHI, Hisao SATO, Chukichi KANEDA and Keiko MITA (Japanese Journ. Breed. **6**, 212–216, 1957)

(1) The mechanism as well as the genetical behaviour of the stiffness in the husking of the naked barley has been investigated in this experiment. The stiffness in the husking is determined by means of the artificial separation of glume from the grain.

(2) The difference in the degree of stiffness in the husking was found in the naked barley varieties. The degree of separation of glume from the grain were over 90%, 60%~90% and 3%~7 in the semi-brachytic type, normal type and also in the stiff varieties of the normal type respectively.

(3) High correlation between the ratio of the width to length of the opening of the outer glume and the degree of separation of glume from the grain was observed.

(4) The difference in the shape of the grain between the normal type varieties and the semi-brachytic varieties were clearly explained by Dr. TAKAHASHI in 1942. In this experiment the authors observed that the difference in the shape of the grain was significant among the normal type varieties also and it has also been found that the round or broad grains were easy to husk in comparison to the narrow grains.

(5) The normal type plants, bearing the grains which are easy to husk, have been found in the F_2 population of 8 crosses, obtained from the naked, covered, normal and semi-brachytic types. The heritability value of the characters concerning the shape of the grain was relatively high.

11. Physiological and genetical studies on the integument in Lepidoptera. Part 1. On some biochemical substances in the wing of butterfly. Hitoshi WATANABE (Journ. Seric. Sci. Japan **25**, 300–302, 1956)

In order to make clear the relationship between uric acid and the pigment formation in the wings of butterfly, a few pterins have been discriminated by paper chromatography and the amount of uric acid has been measured.

It has been observed that xanthopterin-rich wings of *Eurema hecabe* contain more uric acid than those of *Pieris meleta* and white type of *Colias hyale poligraphus* contained much leucopterin. On the contrary, the wings of *Papilio maackii satakei* and *Neptis aceris* having much melanin contain less uric acid than those of *Pieris meleta* and white type of *Colias hyale.*

The above mentioned quantitative relations among pterins, melanin and uric acid can be favourably compared with the results of ARUGA's studies on the larval integument of *Bombyx mori.*

Part 2. On some characters in the larval integument of "Aka-aka-aka" mutant, *Bombyx mori* Hitoshi WATANABE (Journ. Seric. Sci. Japan **25**, 303–306, 1956)

"Aka-aka-aka" or "red blood" (*rb*) is a spontaneous mutant of the silkworm, characterized by the haemolymph containing much 3-hydroxykynurenine and turning to red when it is left in the air. Besides, the mutant has a red skin but its color is much darker than "Reddish".

The present study has been carried out to know the character of the red pigment in the larval integument of "Aka-aka-aka" and the relation between the red pigment and other pigment formations. "Aka-aka-aka" was crossed with other mutants such as "Striped" (p^s), "distinct translucent" (*od*), "chocolate" (*ch*), "Striped-chocolate" (p^s *ch*) and "lemon-chinese translucent" (*lem oc*). Then the respective integuments of rb larvae in the 5th instar segregated in F_2 were observed by employing the micro-technique.

It has been observed that the red pigment of *rb* larva is present in granular form in the secondary cuticle. The red pigment formation in p^s *rb* is completely inhibited in the striped part, but takes place in the white one. On the contrary, the red pigment is not formed in the white part of p^s *ch rb* but is formed in some degree in the striped part. It has been recognized that the red pigment formation is strongly

inhibited in *lem rb* and *oc rb*, but in these cases the amount of xanthopterin-B in the former decreases and the skin color of the latter is as red as that of *rb* owing to the transparency of the integument.

From the above mentioned results, it is plausibly considered that the red pigment formation of "Aka-aka-aka" has an intimate relation with the melanin and the xanthopterin-B formation.

Part 3. On the red color in the larval integument of "Aka-aka-aka" mutant of *Bombyx mori*. Hitoshi WATANABE and Yoshinobu ARATAKE (Journ. Seric. Sci. Japan **25**, 333–337, 1956)

After crossing "Aka-aka-aka" with C-122 and N-122, individuals segregated in F_2 and the backcross have been examined for the red color of the blood and the larval integument. It has been ascertained that the red color of the larval integument of "Aka-aka-aka" is controlled by the action of *rb* gene which is concerned with the production of much 3-hydroxykynurenine in blood. It has been considered from the results of the implantation experiments of the integument that the red color of the larval integument is due to the fact that much 3-hydroxykynurenine is produced in the blood by the action of *rb* gene and then a part of it is transferred to the epidermal cell of integument as the chromogen of the pigment.

It has been observed that there is a large variation in the red color of the "Aka-aka-aka" larvae segregated in the backcross or in the F_2 of the crossing between the "Aka-aka-aka" and the normal. As a result of the investigation, the following four factors have been considered to be the cause of variation; f_0 is a factor concerned with the production of much 3-hydroxykynurenine in the blood and it is a fundamental factor for the red color of integument, f_1 is a factor controlling the amount of 3-hydroxykynurenine in epidermal cells which are transported from the blood into the integument, f_2 is a factor concerned with the tyrosisase activity in the integument, and f_3 is a factor controlling the amount of tyrosine in the integument.

12. Biochemical studies on voltinism in Lepidoptera. Part 5. On the egg color of the polyvoltine race in the silkworm, *Bombyx mori*. Narumi YOSHITAKE (Journ. Seric. Sci. Japan **25**, 430–434, 1956)

When the suboesophageal ganglion of the silkworm is implanted in polyvoltine silkworm larva which has been determined to lay the non-hibernating eggs, many of the resultant moths deposit a number of hibernating eggs. The hibernating eggs laid by the polyvoltine race present a brownish yellow color, although the hibernating eggs show a brownish purple color in the normal strains. The genetical analysis of the egg color and the translucency of the integument of the polyvoltine races have been carried out. From the results of the experiments, it has become evident that the polyvoltine race carries the white-3 (w_3) gene and the manifestation of the translucency is caused by the pleiotropic function of w_3 gene. The degree of the color tone of the eggs and the ganglia is not the same in different polyvoltine races, even though these races carry w_3 gene with them. It may be suggested from the above mentioned phenomena that there is a causal relation between some characters and ecological adaptability of the polyvoltine races.

Part 4. On the difference in the function of the ovaries, between pupae producing non-hibernating and hibernating eggs, in the experiment of ovarian implantation in the silkworm, *Bombyx mori*. Narumi YOSHITAKE (Journ. Seric. Sci. Japan **25**, 434–438, 1956)

An ovary of the silkworm larva with genotype $+^{w1}$ (normal) was implanted in the larva having genotype w_1 (white-1). When the implanted ovary successfully developed in the host moth, compound eyes and the serosa of eggs of the host which should have white eyes and noncolored serosa showed the pigmentation and were apparently the same as in the normal strain having $+^{w1}$ gene, although the degree of modification was not the same in the individuals. The normal strain $(+^{w1})$ ovary was implanted in the w_1 larva determined to lay the non-hibernating eggs, and the compound eyes of the host moth were colored. But in a reciprocal experiment an ovary of the silkworm larva with genotype w_1 was implanted in the normal strain larva. It was found that the implanted ovary did not bring about any modification phenotypically in the color of the compound eyes and the serosa of eggs laid by the host. On the other hand the amounts of kynurenine and 3-hydroxykynurenine of ovarian tubes of the host and donor in various cases of the implantation were discriminated by the method of the paper chromatography. From these experiments some assumptions regarding the difference in the function of ovaries between pupae producing hibernating and hibernating eggs were made:

1) Kynurenine and 3-hydroxykynurenine are not transmitted from the blood to the egg directly, but the precursors of both chromogenes are transmitted to the egg and are changed into kynurenine or 3-hydroxykynurenine in the egg.

2) Non-hibernating egg contains much less kynurenine, 3-hydroxykynurenine, and some substances than the hiberating one. For the understanding of the above mentioned phenomena, it may be plausibly thought that even if those substances are transmitted from the blood to the ovary, some of them are not accumulated in the ovary, but pass through at once into the blood.

13. Studies on a mosaic disease of squash in Japan. Part 1. Its symptoms, host range and transmission. Yasuo KOMURO (Ann. Phytopath, Soc. Japan **21** [4], 162–166, 1956)

A mosaic disease of squash (*Cucurbita maxima*) and pumpkin (*C. moschata* and *C. Pepo*) occurs extensively in the Kanto District of Japan. Its initial symptoms consist of faint veinclearing and green leaf mottling, developing into a mosaic. The typical veinbanding with dark green raised areas is infrequently observed. The most conspicuous and spectacular symptom is the presence of filiform leaves. Namely, the infected leaves are reduced to only a veinous system with patches of green mesaphyll, followed by a severe distortion of leaves especially when the plants have been infected in their early stages of growth.

The virus isolated from squash was readily transmissible by mechanical inoculation with carborundum, or by aphids, viz. *Aphis gossypii* and *Myzus persicae*, but not by cucumber beetle, *Aulacophora femoralis*. It was found to be seed-borne in a certain variety of squash, although the percentage of infection was low (0.6%).

The virus was capable of infecting plants of 10 species in 2 families amongst the 73 species belonging to the in 25 families that wire tested. Systemic infection

was obtained on squash, pumpkin, cucumber, melon, oriental pickling melon (*Cucumis Melo* var. *Conomon*), white gourd (*Benincasa hispida*), white flowered gourd (*Lagenaria leucantha*) etc. Local necrotic spots was developed on *Chenopodium album*. From these results, the virus seems to be practically confined to the Cucurbitaceae. Accounts of the physical properties and identification of the virus will be given in the next paper.

14. The mechanism of action of insecticides and how to study it. Teruo YAMASAKI and Toshio ISHII (Ôyô-Kontyû **10**, 128–133, 1954)

The course of insecticide after application, the factors affecting the insecticidal action in this course, the actions of chemicals at the sites of action in the insect, and the methods of investigations are discussed in this paper.

The insecticide applied arrives at the body surface of insect, enters into the body and reaches the site of action. There are some extrinsic factors intervening in the course of reaching the insect after application: method of application, character of insecticide or environmental factors. After reaching the insect the insecticide may act pharmacologically at the body surface, during the course of reaching the site of action, or at the site of action. The intensity of these pharmacological actions of insecticide depends upon the character of the insecticide such as concentration or physical and chemical properties, the environmental factors such as temperature or humidity, and the character of the insect body such as species, strain, sex, stage of development or physiological conditions. These processes of the insecticide reaching the site of action after application and the factors involved in the course of insecticidal action are shown in a table.

The pharmacological actions of insecticide after reaching the body surface of insect are further discussed in detail. Most insecticides begin to work after entering the insect body. There are three ways of entrance—through the cuticle, the mouth and the spiracles. The pharmacological action of insecticides which have entered the body by these ways can be further considered in three ways. Translocation-distribution in the body, the metabolism of the insecticide and the toxic action at the site of action. Practical examples of these events are shown.

The analyses of these pharmacological actions in the insect body should be carried out as follows. At first we carefully observe the symptoms of poisoning and consider which organ has suffered changes in its function to cause the symptoms and then study these changes physiologically, e.g., with the aid of electrophysiological technique. Next we study the mechanism of the change in function by various methods—for instance enzyme chemistry—and the change in ionic permeability of the nerve membrane. It is only when we have come to this stage of research that we can discuss the relation between the chemical structure of insecticide and its toxic action. It is of great importance for us to know the primary action of the insecticide at the site of action. Practical examples of the primary actions of the insecticides and their sites of action are shown.

15. Studies on the mechanism of action of insecticides. Part 11. Susceptibility of insect to insecticides and method of its investigation. Teruo YAMASAKI and Toshio ISHII (Ôyô-Kontyû **11**, 168–172, 1955)

It is a widely accepted fact that the effectiveness of insecticides depends upon both intrinsic factors (species of insect, strain, developing stage, sex, voltinism, nutritional factors, etc.) and extrinsic factors (temperature, humidity, etc.), and that the various analogues of insecticides have different toxicities. In this report we have described a new method for the study of the cause of these different toxicities. It is necessary to determine the insecticidal action by both topical application and injection and also the effectiveness of insecticides to the dissected or exposed insect preparation. By proper calculations of these data, the step of the poisoning process which is the real cause of the different toxicity can be evaluated. This may be the first step of the study or the most fundamental investigation for further detailed analyses.

The effectiveness of γ-BHC on the house fly and on the American cockroach was measured and calculated by this method. It has been shown that the detoxifying activity for γ-BHC is stronger in the cockroach than in the house fly and this is the cause of the lower toxicity of topically applied γ-BHC to the cockroach.

16. On the method of distinguishing between dead and living ruby scale. Jun MITSUHASHI, Teruo YAMASAKI, Toshio NARAHASHI and Jun-ichi FUKAMI (Ôyô-Kontyû **12**, 162–170, 1956)

It usually takes a long time to differenciate between dead and living scale insects treated with insecticides. In this report we have studied several simple methods for distinguishing between the dead and living ruby scales *Ceroplastes rubens* MASKELL shortly after treatment with hydrogen cyanide.

1. YAGI's methylene blue method was tried, but it was determined that this method could not be practically used.

2. Tyrosine method was devised: A homogenate of the insect was incubated for 24 hours at 30°C with a substrate solution of 0.5 g tyrosine in 100 cc of 50 per cent methanol. The colour of the homogenate was then examined. It has been concluded that this method is applicable in summer but not in winter due to the weak activity of insect tyrosinase at low temperatures.

3. Alkali method was devised: The viscosity of the insect homogenate to which was added one drop of 2.5 per cent sodium hydroxide was a very distinct criterion for distinguishing between the dead and living scales. The homogenate of the living insect had a much higher viscosity than that of the dead one as shown when a glass rod was lifted from the homogenate.

4. Hydrogen peroxide method was also devised: The bubbling in the homogenate when the insect was homogenized with 3 per cent hydrogen peroxide could be a criterion for distinguishing between the dead and living. The degree of bubbling was much lower in the dead insect than in the living insect.

5. Body fluid method was devised: The body fluid colour of the insect treated with high concentration of hydrogen cyanide changed shortly after treatment, but with the low concentrations usually used it took at least 3 days for the colour change to occur.

6. In order to confirm the toxicity of the field applied concentrations of hydrogen cyanide to the ruby scale, individuals were taken from treated citrus trees and placed in a WARBURG respirometer. The lack of activity confirmed the death

of the scale insects.

7. Of all the methods tried in this experiment, the alkali method using sodium hydroxide was considered to be the most practical for use in the field.

17. Studies on the mechanism of action of insecticides. Part 12. Effects of oxygen lack, metabolic inhibitors, and DDT on the resting potential of insect nerve. Teruo YAMASAKI and Toshio NARAHASHI (Botyu-Kagaku 22, 259–276, 1957)

The effects of *p,p'*-DDT, its ethoxy analogue, methoxychlor, and γ-BHC on the resting potential of the cockroach nerve cord have been studied and compared with the effects of oxygen lack, metabolic inhibitors, and potassium ions.

1. The resting potential, a potential difference between an uninjured central region of the nerve and a cut peripheral end soaked in RINGER-isotonic KCl solution, attains the mean value of 40.8 mV.

2. The resting potential has a tendency to decline when the rearing temperature of the roaches is lowered.

3. The resting potential declines rapidly when nitrogen is introduced into the nerve chamber, attaining the maximum value of 50 per cent of the resting potential within 30 to 60 minutes. The potential returns to the normal level very rapidly on a readmission of oxygen or air, and often shows an overshoot of the potential. An anoxia-sensitive fraction of the resting potential was named "aerobic resting potential", while an anoxia-insensitive fraction, "anaerobic resting potential".

4. The aerobic resting potential declines gradually in oxygen or air over a long period of time, but the anaerobic one is maintained at a constant level.

5. Sodium pyruvate, sodium lactate, glucose and sucrose have no effect on the resting potential and the anoxic depolarization.

6. The nerve is depolarized whether the nerve is soaked in monoiodoacetate solution or the nerve is locally treated with it. Lower concentrations of monoiodoacetate depolarize largely the aerobic resting potential, while higher concentrations completely depolarizes the aerobic resting potential and partly depolarizes the anaerobic resting potential. The presence of sodium pyruvate or sodium lactate in the solution does not alter the effect produced by monoiodoacetate.

7. Sodium fluoride also depolarizes the nerve whether the soaking or the local application method is applied. Above threshold concentrations, it equally depolarizes both the aerobic and the anaerobic resting potentials.

8. A local application of KCN brings about a depolarization, which is followed frequently by a partial repolarization.

9. *p,p'*-DDT has no effect on the resting potential and the anoxic depolarization when locally applied.

10. *p,p'*-DDT shows some effects when the nerve is soaked for several hours in DDT RINGER: the nerve is much more depolarized in the presence of DDT while it is soaking in RINGER, and the rate of the repolarization brought about after mounting it on the electrodes decreases. Such a depolarization in the presence of DDT is brought about by an equal depression of both the aerobic and the anaerobic resting potentials.

11. *p,p'*-DDT has no effect on the depolarization produced by a cathodal current, but slows the rate of the repolarization after removal of the current.

12. Ethoxy analogue of *p,p'*-DDT and methoxychlor have the same effect as that of DDT on the resting potential and the anoxic depolarization. γ-BHC has no effect upon them.

13. 15 mM K^+ brings about a depolarization. It depolarizes both the aerobic and the anaerobic resting potentials equally.

14. These data were discussed in the light of the knowledge of metabolism and function of the nerve and the effects of DDT on the nervous function and metabolism in insects obtained to date, and then a hypothesis was proposed. It was suggested that DDT affects the nerve function by changing the ionic permeability of the nerve membrane, and that such a change in permeability is caused by either the action of DDT on the active metabolism of the nerve or the direct physico-chemical action of DDT on the nerve membrane.

Part 13. Increase in the negative after-potential of insect nerve by DDT. Teruo YAMASAKI and Toshio NARAHASHI (Botyu-Kagaku **22**, 296–304, 1957)

The effects of DDT on the negative after-potential and the recovery process of the cockroach nerve were investigated using an amplifier and an oscilloscope.

In the crural nerve of the DDT poisoned cockroach, the negative after-potential was augmented and prolonged markedly in any of the three earlier stages of poisoning symptoms at low temperatures to such a extent that the duration of the action potential was greater than 2 milliseconds, often over 10 milliseconds. The duration of the action potential in the unpoisoned cockroach was 1.73 millisecond at 16.5°C. In the crural nerve of the cockroach which had recovered from the poisoning symptoms after raising the temperature to 29°C, the negative after-potential never decreased.

In the central nerve cord of the poisoned cockroach or in the nerve cord treated with DDT after excision from the untreated cockroach, the negative after-potential was also augmented and prolonged markedly, often lasting more than 30 milliseconds.

Although the normal or the untreated nerve never showed a supernormal phase, the nerve excised from the DDT poisoned cockroach showed a markedly increased supernormal phase.

These results were discussed in the light of our preceding papers and the literatures concerning the mode of action of DDT and the nature of the after-potential in the nerve.

Part 14. Intracellular microelectrode recordings of resting and action potentials from the insect axon and the effects of DDT on the action potential. Teruo YAMASAKI and Toshio NARAHASHI (Botyu-Kagaku **22**, 305–313, 1957)

The resting and action potentials of the giant axon of the cockroach were recorded by means of intracellular microelectrodes, and the effects of DDT upon them were preliminarily examined.

1. The resting potentials fell in the range of 56.5∼72.6 mV, giving a mean value of 64.5 mV in the 25 experiments.

2. The heights of the action potential fell in the range of 77.7∼117.0 mV, giving a mean value of 92.2 mV in the 25 experiments. The reversed membrane potentials fell in the range of 11.5∼50.3 mV, giving a mean value of 27.7 mV.

3. The spike action potential was followed by a positive phase. The height of

this phase fell in the range of 0.7∼4.9 mV, giving a mean value of 2.8 mV.

4. The maximum rates of rise of the action potentials fell in the range of 259∼865 V/sec, giving a mean value of 548 V/sec. The maximum rates of fall of the action potentials fell in the range of 169∼500 V/sec, giving a mean value of 278 V/sec.

5. An application of DDT to the nerve brought about an appearance of the negative after-potential, which was progressively increased in both magnitude and duration with the advance of time. The positive phase often remained unchanged even after developing the negative after-potential.

These findings were discussed in the light of the ionic theory of the membrane potential and by comparison of the existing data on other animals.

Part 15. Effects of metobolic inhibitors, potassium ions and DDT on some electrical properties of insect nerve. Teruo YAMASAKI and Toshio NARAHASHI (Botyu-Kagaku **22**, 354–367, 1957)

The present investigation was undertaken to gain further informations supporting our hypothesis concerning the mode of action of DDT upon nerve which had been described in the previous paper. Observations were made on the resting potential, excitability and the electrotonic potential of the cockroach nerve under the influence of metabolic inhibitors, potassium ions or DDT, and the effects of metabolic inhibitors, potassium ions or electrotonus on the DDT-induced negative after-potential were also examined.

1. The catelectrotonic and the anelectrotonic potentials were observed in the normal nerve.

2. A cathodal current, the strength of which did not cause a conduction block, had little effect on the shape of the action potential, whereas an anodal current reversibly caused an appearance of a large negative after-potential which was hardly observed in the normal nerve.

3. 5×10^{-2} M sodium monoiodoacetate (IAA) caused a nerve depolarization followed by a conduction block. The catelectrotonic potential was not changed by IAA, while the anelectrotonic potential was depressed keeping its shape unchanged. The conduction block was restored by an anodal current. This restoration was removed within several seconds upon switching off the anodal current.

4. 5×10^{-2} M or 7.5×10^{-2} M sodium fluoride caused a nerve depolarization, but a conduction block was never observed. Both the catelectrotonic and the anelectrotonic potentials were depressed in magnitude by NaF keeping their shape almost unchanged.

5. 1.5×10^{-3} M or 3.1×10^{-3} M potassium cyanide caused a nerve depolarization followed by a conduction block. Both the catelectrotonic and the anelectrotonic potentials were either not changed by KCN or slightly depressed in magnitude keeping their shape unchanged. The conduction block was restored by an anodal current. This restoration was removed upon switching off the anodal current, but it took about 30 to 60 seconds to reproduce the conduction block.

6. 4.6×10^{-3} M or 1.5×10^{-2} M potassium cyanide caused a rapid depolarization of nerve in most cases, but the depolarization was restored within several minutes in spite of the continuous presence of KCN. A conduction block was then brought about even when the resting potential had already returned to the normal level. Both

the catelectrotonic and the anelectrotonic potentials were either not changed by KCN or slightly depressed in magnitude keeping their shape unchanged in nearly half of the total cases. In a few cases the anelectrotonic potential was slightly depressed in magnitude, the catelectrotonic potential being kept unchanged. The recovery from the conduction block by an anodal current was the same as that in the case of 1.5×10^{-3} M or 3.1×10^{-3} M KCN treatment.

7. 1.3×10^{-4} M rotenone caused a nerve depolarization followed by a conduction block. The catelectrotonic potential was never affected by rotenone, while the anelectrotonic potential was slightly depressed in magnitude in some cases keeping its shape unchanged. The conduction block was restored by an anodal current. This restoration was rapidly removed immediately after switching off the anodal current.

8. 8.5×10^{-2} M K^+ caused a nerve deploraziation followed by a conduction block. Both the catelectrotonic and the anelectrotonic potentials were markedly depressed in magnitude, and their slow phases were much more depressed than their rapid phases. The conduction block was restored by an anodal current. This restoration was removed within 30 seconds after switching off the anodal current.

9. The resting potential was not affected in most cases by 1.4×10^{-4} M DDT, and was slightly decreased in a few cases. A conduction block was never observed. The catelectrotonic potential was not depressed in magnitude, but its falling phase was delayed. The anelectrotonic potential was either not changed or slightly depressed in magnitude keeping its shape unchanged.

10. The DDT-induced negative after-potential was augmented and prolonged by an anelectrotonus and completely disappeared by a catelectrotonus. It disappeared before a conduction block occurred after the application of 5×10^{-2} M IAA, 3.1×10^{-3} M or 4.6×10^{-3} M KCN, or 1.3×10^{-4} M rotenone, but 7.5×10^{-2} M NaF or 8.5×10^{-2} M K^+ had no effect upon it.

11. Discussions were made on the following points: the possibility that metabolic inhibitors act selectively upon either of the resting or the active metabolism of nerve, mechanism of anodal restoration from the conduction block produced by metabolic inhibitors or potassium ions, the evidence that DDT has no effect on the resting metabolism of nerve, and the speculation that DDT-induced negative after-potential is caused by a stimulating action of DDT on the active metabolism of nerve.

II. Agricultural Chemistry

Abstract Nos. 18—46

18. Physico-chemical studies on the formation of humic acids. Part 9. X-ray diffraction analysis and coagulation by electrolytes. Kyôichi KUMADA (Journ. Sci. Soil and Manure, Japan **27**, 79, 1956)

On various humic acids, X-ray diffraction analysis and coagulation experiment by the addition of electrolytes were performed, and the following conclusions were obtained.

1. Sensibility of soil humic acids for electrolytes increases with the progress of humification.

2. It may be considered that humic acids showing low degree of humification are amorphous, but in the case of humic acids showing higher degree of humification, the existence of amorphous carbon-like structure becomes clear with the progress of humification.

Part 10. Soil types and forms of humic acids. Kyôichi KUMADA (Journ. Sci. Soil and Manure Japan **27**, 119, 1956)

Some preliminary studies were performed on the relationships between chemical properties of various soils and the forms of their humic acids.

The soils were arranged according to humification degree of their humic acids as follows; muck soil>humus-volcanic ash soil>Jagaru (a rendzina-like soil in Okinawa Isle)>alluvial soil>diluvial soil. It was noticed that the forms and the amounts of humic acids depended upon not only acidity, calcium cotent, aeration etc. of the soil, but also its geological origin, to a remarkable extent.

Part 11. Stability of artificial humic acids. Kyôichi KUMADA (Journ. Sci. Soil and Manure Japan **27**, 175, 1956)

In order to obtain artificial humic acids which are as stable as soil humic acids, that is, highly resistant to oxidizing action and hardly decolorizable in their alkaline solutions, more than 30 sorts of humic acid-like substances were prepared from charcoal and organic compounds having benzene, naphthalene or anthracene ring etc. by chemical or enzymic actions, and their stabilities and absorption spectra were determined.

The most stable artificial humic acid was obtained from charcoal by treating with $KClO_3$ and HNO_3, and melanin humic acids were also fairly stable. These stable humic acids showed absorption spectra similar to those of soil humic acids.

19. On Clay Minerals of "Irihama" Salt Field Soils and Sea Muds around the Inland Sea of Seto. Kenzô KÔBÔ and Tôru FUJISAWA (Journ. Soc. Salt Sci. **11**, 54–61, 1957)

In connection to the investigation to throw light on the empirical fact that sea muds are more excellent than upland soils as the material for the ground of "Ryuka" salt field, we conducted the mineralogical survey on clay fractions separated from salt field soils and sea muds around the Inland Sea of Seto in comparison with the clay fraction separated from upland soil of Mikatagahara by carrying on the differential thermal analysis, the X-ray analysis, the chemical analysis, the cation exchange capacity measurement and the ethylenglycol absorption measurement with the samples. The results obtained are as follows.

(1) The chief difference between upland soil clay and salt field soil clay as well as sea mud clay is that the clay mineral of the former is halloysite but the latter contains three layer lattice mineral, illite or chlorite, besides halloysite.

(2) The salt field soil clay in Kagawa prefecture and the sea mud clay in the Matsunaga bay (Hiroshima prefecture) consist of hydrated halloysite, halloysite and illite; on the other hand both the salt field soil clay and the sea mud clay in Tokushima

prefecture consist of chlorite and illite mixed with hydrated halloysite and halloysite.

(3) From the above results it is suggested that the mineralogical composition of the salt field soil clay and sea mud clay has close connection to their parent rock rather than their environmental conditions.

20. Dynamic studies on nutrients uptake by crop plants. Part 13. The effect of metabolic inhibitors such as NaN_3; NaF; IAA; MA; NaCl; 2·4–D, and DNP, particularly NaF on the nutrients uptake by rice plant. Shingo MITSUI and Kikuo KUMAZAWA (Journ. Sci. Soil and Manure, Japan **27**, 440, 1957)

The effect of several metabolic inhibitors such as sodium azide, sodium fluoride, iodoacetate, malonate, sodium chloride, 2,4-dichlorophenoxyacetic acid and 2,4-dinitrophenol on the nutrients uptake by rice plant was studied. Utilizing mature rice plants the following results were obtained.

1) 2 4-dinitrophenol (ca 10^{-2} M), sodium azide (1×10^{-2} M), sodium malonate (5×10^{-2} M) and sodium iodoacetate (1×10^{-2} M) markedly inhibited root respiration as well as nutrients uptake. Phosphorus and potassium which is probably linked more directly to the metabolic cycle during their absorption processes, were excreted; ammonium nitrogen, water uptake and respiration were depressed.

2) Sodium chloride (1×10^{-2} M) depressed water uptake especially among other elements. It was supposed that at the first step the high osmotic pressure of the culture solution caused damage to plant cells similar to drought followed by the inhibition of metabolism and salts uptake.

3) Sodium fluoride (1×10^{-2} M) remarkably inhibited potassium uptake, but not so much phosphorus, ammonium nitrogen and water uptake, whereas the respiration rather increased.

Further, the inhibition was precisely re-examined with rice seedlings, changing the concentrations from 0 to 10^{-1} M NaF. At lower concentration of NaF (10^{-4}, 10^{-3} and $1\text{-}0^{2}$ M), the uptake of phosphorus, ammonium nitrogen, water and oxygen was not or very slightly decreased; the uptake of potassium decreased, almost proportional to the concentration of NaF. At the highest concentration of NaF (10^{-1} M) potassium and phosphorus were even excreted out, and the uptake of ammonium nitrogen, water and oxygen was remarkably depressed, similar to 10^{-2} M NaN_3. By the use of radioactive phosphorus, it was demonstrated that sodium fluoride inhibited only phosphorus translocation from root to shoot, but it is indifferent to phosphorus accumulation in roots. This can be explained on the assumption that, at the first step of accumulation of phosphorus, its esterification by such pathway as oxidative phosphorylation etc., is required, and the phosphate splitting off catalized by phosphatase etc. precedes its excretion to xylem. By comparatively low concentrations of sodium fluoride, the latter process possibly might have been inhibited and by comparably higher concentration the former via enolase or succinic acid oxidase inhibition. Potassium uptake is believed to be linked with this dephosphorylation process by supplying some binding body or bonding energy of potassium.

21. Leaching of sulfate and calcium as influenced by particle size of fertilizers. Shingo MITSUI, Masaaki MORIYAMA and Kiyoshi TENSHÔ (Journ. Sci. Soil and Manure, Japan **27**, 481, 1957)

It is very important to clarify the movement of sulfate in the paddy soil, especially with regard to the physiological damage of paddy root.

A pot lysimeter experiment was conducted to measure the sulfate and calcium, leaching out from an alluvial paddy soil, in relation to the particle size of fertilizers including both ions as its complementary ions.

The results showed that the amounts of sulfate and calcium in the leachates had similar trend of seasonal change except for sulfate of non-fertiliser pots which was exceptionally low in the total amount. This means that the greater part of the leached sulfate was derived from the applied fertiliser, and the leached calcium was largely due to the native soil calcium via base exchange.

Further, the leached sulfate showed little differences through granulation; the leached calcium, on the contrary, decreased as the particle size of fertilizers increased.

This may possibly by explained according to the hypothesis that the path-way of leached ions from larger granulated fertilisers is restricted to the smaller part of soil columns as compared with powdered fertilisers, thus restricting base exchange and sulfide contamination with a limited area of the furrow slice.

22. Fe-EDTA chelate for water culture. Katura TUZIMURA and Fumiyo IKEDA (Journ. Sci. Soil and Manure, Japan **27**, 1, 1957)

Precipitation of iron was compared, from water culture solutions including ferric ethylendiamine tetraacetate, citrate and chloride. Fe-EDTA was most effective to hold iron in the solution at pH 5 to 6. EDTA and citrate were equally effective at pH 4, both being less effective at pH 8.

Excellent growth was obtained in water culture of rape, wheat and rice, using Fe-EDTA. Ferric chloride was not equally good.

23. Electrolytic reduction of physiologically important substances at controlled potential. Part. 1. A partially active product of diphosphopyridine nucleotide. Tetsurô KÔNO (Bull. Agr. Chem. Soc. Japan **21**, 115-120, 1957)

By means of the electrolytic reduction of diphosphopyridine nucleotide at controlled potential using mercury as the cathode, the author obtained a product which showed an absorption spectra similar to that of dihydrodiphosphopyridine nucleotide. About 2.5 mg of DPN was dissolved in 25 ml of 0.1 M. phosphate buffer, pH 7.2, and was reduced at the cathode potential of -1.75 volt vs. S.C.E. for 30 mins. The absorption spectrum was comparable with that of DPNH obtained by dithionite reduction. Optical density at 340 mμ diminished for ¼～½ with the addition of alcohol- or malic acid-dehydrogenase system. The same absorption band, however, completely disappeared when an extract of mung nean seedlings were added.

24. A micro amperometric titration of thiol-group in plant by the use of a vibrating platinum electrode. Yasutoyo NAGAI, Tetsurô KÔNO and Saburô FUNAHASHI (Ibid. **21**, 121-125, 1957)

A method for the micro amperometric titration of thiol group as small as from 0.1 to 1.0 μ mole, corresponding to 10-100 μg of cystein, is described. The thiol group was titrated in ammoniacal solution in a stream of nitrogen with 0.002 N of silver nitrate solution, using a special ultra microburette. The course of the titration and

the end point were detected amperometrically using platinum vibrating electrode. The method was suitable for the determination of a minute amount of thiol-groups; especially those found in plant tissues. Contents of acid-soluble thiol compounds in etiolated mung bean seedlings at various stages were determined by the method. The amounts of thiol-group were 150, 60, 120, 150, and 150 mg per 100 g of dry matter, on the 2nd, 4th, 6th, 8th, and 10th day, resp.

25. The balance test of cobalt on goat. Makoto KANDATSU, Bunpei MORI and Toshio OZAKI (Journ. Jap. Biochem. Soc. 28, 571, 1956)

Ruminant animals require a relatively large amount of cobalt in comparison with non-ruminants, probably through the requirement by microflora in their rumen. Cobalt was determined colorimetrically by the o-niroso resolcine mono-methylether method.

In the present study the goat was fed in a metabolic cage under controlled conditions, and the balance test of cobalt was carried out in duplicate, analyzing feces and urine collected for five days.

1) The goat, about 40 kg. in body weight, excretes 220-320 μg. of cobalt during 24 hours. The quantity of cobalt in the excreta is in a state of equilibrium with that of the ingesta.

2) 4-8% cobalt in ingesta is excreted in urine, and the rest of cobalt ingested is excreted in feces.

26. Studies on reticulo-rumen digestion. Part 6. The artificial development of rumen Infusoria. Makoto KANDATSU and Shizuo YAMAMOTO (Jap. Journ. Zootech. Sci. 27, 63-65, 1956)

The development of Infusoria found numerously in the rumen, was re-examined by AKASHI's method using bovine rumen contents.

Rumen contents were obtained from an indigenous goat through a permanent rumen fistula adapted to it. The rumen contents were dried up for different periods of time at different temperatures immediately or after being centrifuged, and used for culture. No motile organisms could be found in any of the samples.

Rumen contents not dried up nor soaked in acid were cultivated with goat's rumen fluid as culture medium. But contrary to the results reported by AKASHI, no motile organisms were found in any of the specimens.

Part 7. The volume of reticulo-rumen liquid in vivo. Makoto KANDATSU, Noriyuki YAZU and Akira MORIYAMA (Jap. Journ. Zootech. Sci. 27, 77-80, 1956)

In order to estimate the effect of microorganisms in the rumen, on the nutrition of the ruminant quantitatively, it is necessary to determine the volume of liquid in the fore-stomach where numerous microorganisms live in an active state.

Several experiments were conducted for this purpose, in which sodium chloride, powder or solution, was put into the rumen of goats through a permanent fistula and the concentration of Cl in the rumen liquor was determined at definite time intervals.

The results obtained are as follows.

1. When the feeding conditions are fixed on the whole, the concentration of

Cl in the liquid part of the rumen content may be assumed practically to be constant.

2. The concentration of Cl in the rumen liquid attains to and remains at an almost constant level, 2 or 3 hours after the administration of sodium chloride, which may be in powder or in solution.

3. From the difference in Cl concentration between the rumen liquids collected before and 2 hours after the administration of sodium chloride, respectively, liquid part of the reticulo- rumen content of goats was calculated as follows.

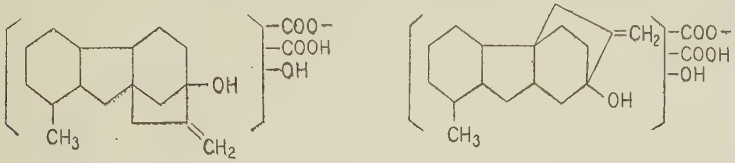
Animal No.	Body Weight	Volume of reticulo-rumen
1	37 (kg)	12.0±1.4 (l)
2	19	8.9±0.4
3	30	(1) 10.8±0.9
		(2) 11.1±0.8

27. Biochemical Studies on "Bakanae" Fungus. Part 17. Chemical Structure of Gibberellins. (7). Hiroshi KITAMURA, Yasuo SETA, Nobutaka TAKAHASHI and Yusuke SUMIKI (Journ. Agr. Chem. Soc. Japan **21**, 71, 1957)

The formula of gibberellin A_2 was corrected as $C_9H_{26}O_6$ from the analytical data of its derivatives and molecular weight determinations. Gibberellin A_1, A_2 and gibberellic acid have the same functional groups (OH 2, γ-lactone 1, COOH 1) except the number of C-C double bond (A_1 1, A_2 0, gibberellic acid 2). On the catalytic hydrogenation of methylgibberellate, it gave dihydrogibberellin A_1 methylester and hydrogenolysis products. From this result, it was concluded that gibberellic acid has one more double bond in some position of gibberellin A_1.

Part 18. Chemical Structure of Gibberellins. (8). Yasuo SETA, Hiroshi KITAMURA, Nobutaka TAKAHASHI and Yusuke SUMIKI (Journ. Agr. Chem. Soc. Japan **21**, 73, 1957)

On the ozonolysis of gibberellin A_1 methylester, formaldehyde, formic acid, a neutral substance ($C_{19}H_{24}O_7$) and acidic substance ($C_{19}H_{24}O_8$) were obtained. Neutral substance is a α-ketol and readily oxidised to acidic substance (I) with H_2O_2. On the dehydrogenation of (I) gave 1-methyl-7-hydroxy fluorene. From this result, we proposed the following partial structure to gibberellin A_1.

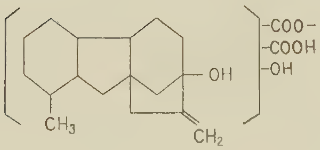


Part 19. Chemical Structure of Gibberellins. (9). Nobutaka TAKAHASHI, Yasuo SETA, Hiroshi KITAMURA and Yusuke SUMIKI (Journ. Agr. Chem. Soc. Japan **21**, 75, 1957)

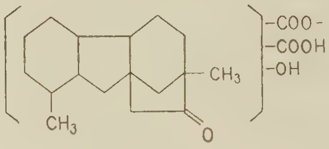
The relation among gibberellin A_1, pseudogibberellin A_1, gibberellin C and isogibberellin A_1 was clarified as shown in the following figure.

The behaviour of gibberellin A_1 to acid (H^+) and bromine (Br^+) and dehydrogenation studies of gibberellin A_1 and gibberellin C lead us to propose the partial structure of gibberellin A_1 (I) and gibberellin C (II).

gibb. A_1	$\xrightarrow{OH^-}$	pseudo gibb. A_1
$C_{19}H_{24}O_6$		$C_{19}H_{24}O_6$
2—OH		2—OH
1—COOH		1—COOH
1—COO-		1—COO-
1 double bond		1 double bond
$\downarrow H^+$		$\downarrow H^+$
gibb. C	$\xrightarrow{OH^-}$	iso gibb. A_1
$C_{19}H_{24}O_6 \cdot H_2O$		$C_{19}H_{24}O_6$
1—OH		1—OH
1>CO		1>CO
1—COOH		1—COOH
1—COO-		1—COO-
no double bond		no double bond



(I)



(II)

28. **On the Studies of Angustmycins. Part 4. Degradation Studies of Angustmycin A.** Hsu Yuntsen & Hiroshi Yonehara (Bull. Agr. Chem. Soc. Japan **21,** 261, 1957)

The acid cleavage of angustmycin A under mild condition yield adenine (I) and a new sugar to which the name angustose (III) was proposed. However, under a more vigorous condition, instead of angustose, allomaltol (II) was obtained, which was proved to be an acid decomposition product of angustose. The characterization and identification of these three compounds are reported in the paper.

29. **Studies on Microbial Biosynthesis of Pantothenic Acid. Part 5. Pantothenate Synthesis from Pantoate and β-Alanine by *Escherichia coli* Extracts.** Akira Matsuyama (Bull. Agr. Chem. Soc. Japan **21,** 47, 1957)

Pantothenate synthesis from pantoate and β-alanine by *Escherichia coli* extracts was studied as a model synthesis of the peptide bond. It was found as evidence for the occurence of pantoyl-carboxyl activation, that a significant quantity of pantoic acid hydroxamate was formed in the reaction mixture containing pantoate and ATP. Formation of pantothenate and development of hydroxamate color from activated pantoate were increased under anaerobical conditions. Inhibition by -SH reagents and reversal of inhibition by thiol compounds are indicative of the evidence for involvement of -SH enzyme in pantothenate synthesis and pantoate activation. In view of these results, pantoate activation is formulated as shown in the following two-step reaction:

(1) $\text{HS-E} + \text{AMP}{\sim}\text{PP} \rightleftarrows \text{PP}{\sim}\text{S}\cdot\text{E} + \text{AMP}$

(2) $\text{PP}{\sim}\text{S}\cdot\text{E} + C_5H_{11}O_2\cdot\text{COO}^- \rightleftarrows C_5H_{11}O_2\cdot\text{CO}{\sim}\text{S}\cdot\text{E} + \text{PP}$

30. Selective Cleavage of α-Glucosidic Linkage in Starch Using Chemical Agents. Part 2. Keisuke HORITSU (Journ. Agr. Chem. Soc. Japan **30**, 738, 1956)

There were many reports on the emzymic action on starch. This study deals with whether the cleavage into a certain length of α-1, 4-lgucosidic linkage or selectively, the branching point of α-1, 6-glucosidic linkage through inorganic acid, organic acid and their esters might occur or not.

As the catalyser, perchloric acid, sulfuric acid and oxalic acid were used and as the substrate, amylose (potato) and amylopectin (potato) were used respectively under the given conditions; (1) catalyser concentration pH 2.1~2.6, (2) substrate concentration 1.0%, (3) a) reaction time 52 hours under the condition of shaking in a boiling water bath (perchloric acid, sulfuric acid and oxalic acid), b) reaction time 2 hours under the condition of shaking at 185°C with amylose, at 165°C with amylopectin, at 165°C with D-glucose (perchloric acid). The results are as follows;

1) It is impossible to find the specific property in the three catalysers individually.

2) The recombination reaction of D-glucose did not occur in the above conditions (perchloric acid).

3) There was no significant difference between the two substrates used in the course of the hydrolysis.

4) The difference in the production of monose, biose and triose between the three catalysers used was not considerable.

5) About the kinetics of the hydrolysis, it will be better on the average to consider this acid-catalysed reaction as a "first order reaction".

31. Microdetermination of Parathion. Yusuke SUMIKI, Akira MATSUYAMA, Hiromichi KATO, Yushih CHEN and Teiji YAMAUCHI (Bull. Agr. Chem. Soc. Japan **21**, 204, 1957)

In the research for sea and river water contamination and damages of marine organisms caused by insecticides, there is a keen need for highly sensitive and specific methods for the determination of insecticides, especially parathion on account of its great toxicity. From the results of the preliminary tests conducted in this laboratory for phosphorus compound determination, the method of SOYENKOFF (λmax. 510 mμ, ϵ 6.1×10^4) and its modified one of this laboratory (λmax. 480 mμ, ϵ 1.5×10^5) have been employed. By the results achieved, the following two procedures have been designed as the most highly sensitive and specific methods for the estimation of small amounts of parathion which are contained in water. The basic steps of Method 1 for the concentration order of p.p.h.m. or more are: (1) Extraction, (2) reduction, (3) development and evaluation of an azo dye color (at 560 mμ), (4) digestion of an azo dye and (5) estimation of phosphorus (at 510 mμ). Those of Method 2 for the concentration order of p.p.b. are: (1) Extraction, (2) condensation and feeding on a paper strip by the total sample feeder designed in this laboratory, (3) paper chromatography with non-aqueous solvent system (hexane layer as a mobile solvent, methanol layer as a stationary solvent), (4) elution of the spot, (5) digestion of parathion and (6) colorimetry of phosphorus (at 480 mμ). The analytical data obtained by Methods 1 and 2 are shown.

32. Studies on Browning Reactions between Sugars and Amino Compounds. Part 1. pH Dependency of Browning Interactions between Various Kinds of Reducing Sugars

and Amino Compounds. Hiromichi KATO (Bull. Agr. Chem. Soc. Japan **20**, 273, 1956)

In 1912, Maillard observed that interaction between reducing sugars and amino acids produces brown products (melanoidin), and in recent years it was demonstrated that this type of reaction plays the most important role in non-enzymatic browning, during storage and processing of foods. For this reason, many investigations have been carried out on the browning mechanism of the simple system, using both reducing sugars and amino compounds. But due to the complexity of this reaction, the mechanism still remains unknown in many respects.

In this paper, the effects of pH, concentration, oxygen and phosphate by the use of various sorts of reducing sugars (D-glucose, D-xylose, lactose and D-fructose) and amino compounds (amino acids, aliphatic and aromatic amines) have been investigated.

It was found that primary aliphatic amine reacts with reducing sugars to produce much more brown colored products than amino acids at the same pH. At 100°C, strong browning interactions were observed in the following cases: first, in an acidic aqueous solution (pH 2-5), between aldoses and aromatic amines; second, in slightly acidic or almost neutral solution (pH 3-8), between aldoses and aliphatic amines or amino acids; third, in an alkaline solution (pH above 8), between aldoses or ketoses and aliphatic amines or amino acids. No oxygen is required for any of these browning reactions. In addition, it is confirmed that the promoting effect of phosphate is remarkable, especially between the ranges of pH 5-9.

Part 2. Significance of N-glycosides for Browning Reactions. Hiromichi KATO (Bull. Agr. Chem. Soc. Japan **20**, 279, 1956)

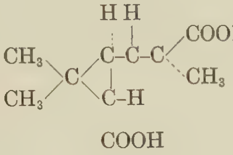
Many investigators proved that amino-carbonyl condensation reaction occurs in the interaction of sugars with amino compounds. Hodge considered that N-glycosides which have been formed by this condensation reaction undergo the Amadori rearrangement as the next reaction step, and products of this rearrangement make browning with amino acids. However, Wolfrom showed that amino compounds promote decomposition of sugars to furfural or other active substances catalitycally, and the carbonyl-amino reaction could occur only to a slight extent if at all in dilute aqueous solutions of aldoses and glycine, although active compounds such as furfural are formed to cause browning with glycine.

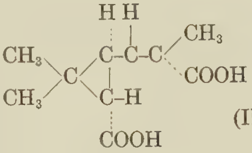
In this paper, the relation between browning and N-glycosides of aliphatic and aromatic amine is described in various acid-catalytic conditions.

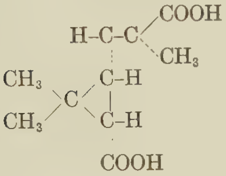
Aldoses react to form 40-45% N-glycosides with p-aminobenzoic acid (PABA) and produce brown substances below pH 6, at 100°C for sixty minutes. But ketoses are inactive under this condition, and N-D-xylosyl-PABA produces the brown substance more rapidly than the mixture of D-xylose and PABA. In 0.1 N acidified methanol solution and acetone suspension at room temperature (27°C), N-aldosides of both aromatic and aliphatic amine cause browning to occur faster than the mixture of sugars and amines. Therefore, it was concluded that browning involved in acid-catalytic condition has N-glycosides, as a precursor. While, on the contrary, N-p-tolyl-D-isoglucosamine does not make browning at room temperature, even in the acidic condition. N-lactosyl-PABA was synthesized and it was observed that this compound also makes browning under the conditions described above.

33. Syntheses of pyrethidic (chrysanthemumdicarboxylic) acid. Masanao MATSUI, Masateru MIYANO, Kyôhei YAMASHITA, Hiroshi KUBO and Kiyoshi TOMITA (Bull. Agr. Chem. Soc. Japan **21,** 22. 1957)

Three racemates of pyrethidic (chrysanthemumdicarboxylic) acid (Ia,b,c) were synthesized by various routes including schemes (1), (2), (3), (4) and (5); thus, the total synthesis of three (Ia,b,c,) of the possible four (Ia,b,c,d) racemates were attained.


(Ia)


(Ib)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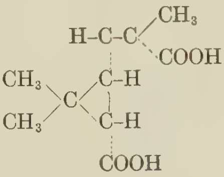
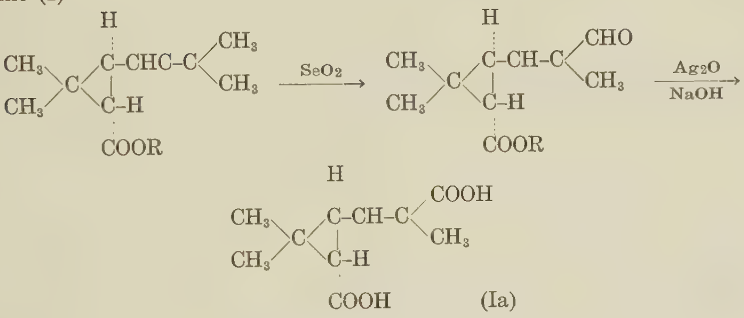
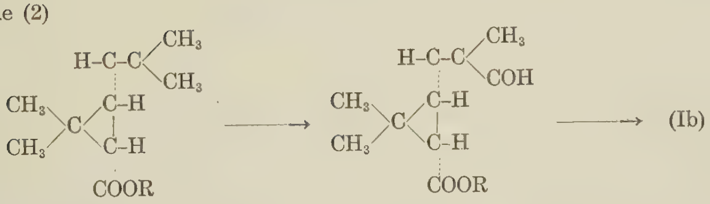

(Id)

Scheme (1)



Scheme (2)



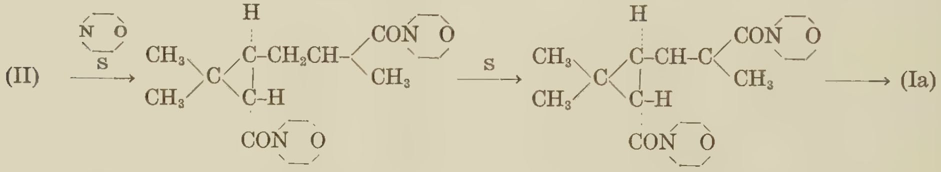
New nomenclature and steric configurations for these racemates are proposed: dl-trans-pyrethidic acid (racemic form of natural d-trans-chrysanthemumdicarboxylic acid) (Ia) m.p. 200° (uncorrected); dl-trans-isopyrethidic acid (geometric isomer concerning double bond) (Ib) m.p. 175-7°; dl-cis-pyrethidic acid (cis-modification concerning cyclopropane ring) (Ic) m.p. 204°; dl-cis-isopyrethidic acid (isomeric with the natural acid both in double bond and cyclopropane ring) (Id) (not yet obtained).

d-trans-Pyrethidic acid, naturally occurring chrysanthemum-dicarboxylic acid, was also synthesized via scheme (2) and its absolute configuration (Ia) was determined.

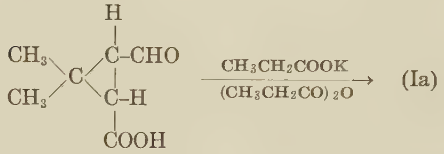
m. p. 163–4°, α_{D}^{19} +72.0 (c, 1.98 in methanol)

Methyl d-trans-chrysanthemate, the starting material for the synthesis of d-trans-pyrethidic acid, was already totally synthesized, therefore our synthesis mentioned above constitutes the total synthesis of the natural d-trans-pyrethidic acid.

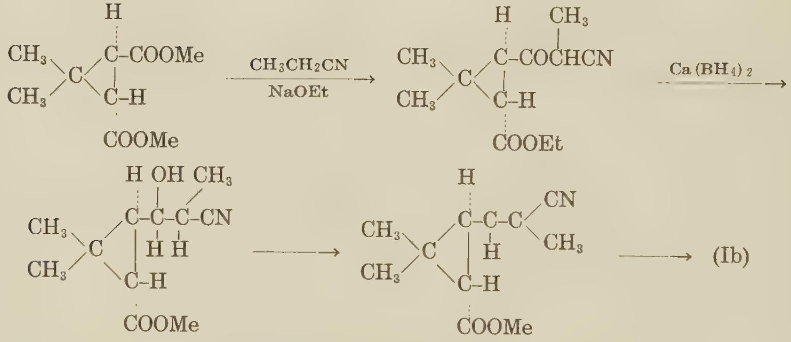
Scheme (3)



Scheme (4)



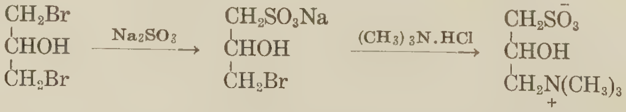
Scheme (5)



34. Studies on compounds related to carnitine. Synthesis of DL-γ-trimethylamino-β-hydroxypropanesulfonic acid (DL-anticarnitine). Masanao MATSUI, Masateru MIYANO and Akira TERADA (Journ. Agr. Chem. Soc. Japan **31**, 233, 1957)

DL-γ-Trimethylamino-β-hydroxypropanesulfonic acid, for which the simple name "anticarnitine" was designated, was synthesized via the below scheme.

Scheme



By the way, N-(γ-Iodo-β-hydroxypropyl)-benzamide (I) and Sodium γ-bromo-β-hydroxypropanesulfonate (II) were synthesized.

(I)

(II)

35. On the enzymatic hydrolysis of lactose. Rinjirô SASAKI and Kôkichi TANIGUCHI (14th International Dairy Congress Proceedings. **1**, [2], 239, 1956)

The differences of lactase action on α-and β-lactose have been studied in order to see whether α- and β-lactose have different physiological effect on the nutrition of infants, or not. Results indicate that lactase has greater affinity to α-lactose than to β-lactose.

36. On the existence of carbohydrates in cow's milk. Rinjirô SASAKI and Kôkichi TANIGUCHI (Journ. Agr. Chem. Soc. Japan **30**, 809, 1956)

The presence of various kinds of sugars in cow's milk was investigated as a part of the studies on the states of lactose. And if lactose is made in milk through the oligosaccharides from the blood sugars, it may be supposed that there are differences between the sugars in the normal milk and that in the mastitis milk. So sugars in the above milk were studied by using chromatographic technique. The multiciple development applied gave clear separation of sugars on the paper and it was brought out clearly that glucose and galactose exist as common components in the normal cow's milk. It was the same as in the mastitis milk. Besides those, there was no spot that is attributed to other monosaccharide. Also each sample contains two other substances, may-be oligosaccharides, which appeared on positions to correspond to R_L value 0.4 and 0.7. But no expected differences between sugars in normal milk and that in mastitis milk were observed.

37. Preparation of Thiamine Salts. Yosito SAKURAI and Kengo OKUMURA (Journ. Vitaminology **2**, 276, 1956)

Twenty four thiamine salts, such as thiamine mono-p-dimethylaminoazobenzene-p'-sulfonate, thiamine meconate, thiamine half-styphnate, double salt of thiamine hydrochloride and zinc chloride, and that of thiamine hydrochloride and cadmium chloride, were synthesized using ion exchange resin. The methods for preparation are described in detail.

38. Action of Fumigants on the Components of Cereals. Yosito SAKURAI and Ihei IWATA (Journ. Jap. Soc. Food and Nutrition **9**, 140, 1956)

Changes in the properties of soybean flour oil, protein and starch during methyl bromide fumigation were studied, and the results obtained are as follows:

(1) Bromine content of the fumigated soybean flour increased and its water soluble nitrogen compounds decreased. But both changes were insignificant for short time treatments.

(2) Bromine contents of casein, gluten and egg albumin increased. But little change was shown in starches of wheat, potato and rice.

(3) There was no change in the properties of the soybean oil, linseed oil and coconut oil.

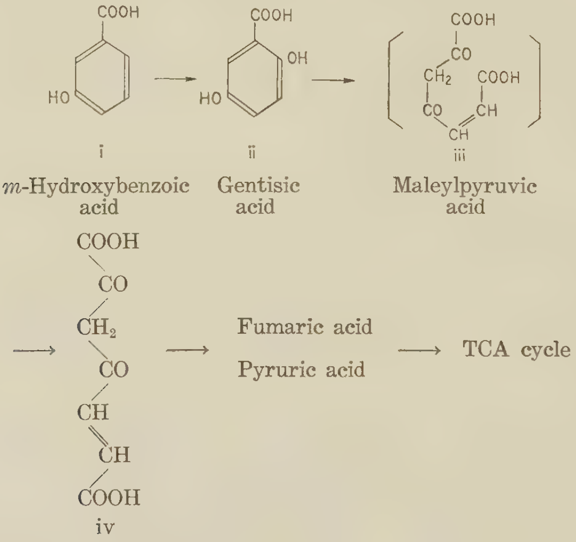
39, Isolation of fumarylpyruvic acid as an intermediate of the gentisic acid oxidation by *Pseudomonas ovalis* var. S-5. (A short communication.) Hirosato TANAKA, Shin-ichi SUGIYAMA, Keiji YANO and Kei ARIMA (Bull. Agr. Chem. Soc. Japan **21,** 67–68, 1957)

The intermediate of the oxidative ring cleavage of gentisic acid was isolated and purified.

The crude extracts prepared from the m-hydroxybenzoic acid induced cells of *Pseudomonas ovalis* var. S-5 were dialyzed against distilled water for the purpose of making the extracts free of the enzyme which hydrolyzes the intermediate. The intermediate was extracted from the reaction mixture of Na-gentisate and the dialyzed crude extracts. It was precipitated from ethylacetate petroleum ether mixture and then recrystallized several times from ethanol-benzene mixture. As the result of chemical analysis, UV and infrared spectra analysis and other chemical reactions, the intermediate proved to be a new diketo-dicarboxylic acid which has a structure as shown Fig. I, iv. It was named by us 'fumarylpyruvic acid'.

The fumarylpyruvic acid was easily hydrolyzed by the non-dialyzed crude extracts of the m-hydroxybenzoate induced cells, giving rise two acids, fumaric acid and pyruvic acid.

Therefore we proposed the following scheme of the oxidative degradation pathway of m-hydroxybenzoic acid by Ps. ovalis S-5.



Fumarylpyruvic acid

40. Studies on plant seeds germination promoting substances which are produced by microorganisms. Part 1. Selection of strains. Yoshihisa KOAZE, Heiichi SAKAI and Kei ARIMA (Journ. Agr. Chem. Soc. Japan **31,** 338, 1957)

For the intention of obtaining plant seeds germination promotants from microbiological products, at the beginning, selection of strains which could markedly

promote the germination of plant seeds, was carried out. In the laboratory seed germination test, the promoting effects for the germination of the pea, cabbage and rice plant seed were examined on the mycelial extracts and the cultural filtrates of typical 25 species of mold (M), 15 species of yeast (Y), 10 species of bacteria (B) and 25 species of streptomyces (S), harvested through the shaking culture. As results: 7 sps. of M, 5 sps. of B, 1 sp. of Y and 1 sp. of S showed the germination promoting effect markedly for the pea seed; 3 sps. of M, 2 sps. of B and 6 sps. of Y for the cabbage seed and 4 sps. of B and 4 sps. of S for the rice plant seed. These promoting effects appeared in concentrations of 1/100 for each test solution. However, in the concentration of 1/10 for each test solution, 16 sps. of M, 3 sps. of B, 2 sps. of Y and 4 sps. of S showed germination inhibiting effect markedly for the pea seed; 9 sps. of M and 1 sp. of Y for the cabbage seed and nothing for the rice plant seed. For the control, the well known plant hormons (K-β-indol acetate, K-α-naphtyl acetate and 2.4-D) and Vitamin B_1 and B_{12} were also examined on the promoting effects for the above mentioned plant seeds. Except that Vitamin B_1 showed the promoting effect for the germination of the pea seed in the low concentration, the promoting effects were never observed for the other plant seeds used and, on the contrary, the plant hormons used, especially 2.4-D, showed marked inhibition with the modificating action in high concentrations for all the plant seeds used. On the other hand, on the well known 18 antibiotics, the same investigations were carried out. Only for the germination of the pea seed, 12 antibiotics, especially neomycin-B, penicillin-G, sarkomycin and streptomycin, showed the promoting effect. However, in the high concentration, 8 antibiotics showed the germination inhibiting effect strongly for the pea seed, 1 for the cabbage seed and 4 for the rice plant seed and especially, cycloheximide showed marked inhibition for all the plant seeds used. At that time, chloramphenicol and tetracycline groups, in the high concentrations, caused the appearance of reddish pigments on the young leaf and on the top of the young stem of cabbage.

41. A New Crystalline Germination Promotor for Plant Seeds, Produced by *Streptomyces* sp. S-580. (Short Communication) Yoshihisa KOAZE (Bull. Agr. Chem. Soc. Japan **21**, 197, 1957)

It has been already reported by Y. Koaze, H. Sakai and K. Arima that culture broth filtrates and/or mycelial extracts of several microorganisms had promoting effects on the germination of some plant seeds in the laboratory seed germination test. Especially, the culture broth filtrate of *Streptomyces* sp. S-580, showed a strong activity, having promoting effects on the germination of the rice plant seed. Therefore, the author attempted to isolate the active substance from this culture broth filtrate and has succeeded to obtain a crystalline substance which could promote the germination of rice plant seed in such concentrations, as low as 0.1 mcg./ml. This crystalline substance did not show any antibiotic activity. A heavy oily syrup with high activity was obtained by extracting the culture broth filtrate of *St.* sp. S-580 with ethyl acetate. By the chromatographic technique using aluminium oxide, an active factor was obtained from the above syrup in the crystalline form. (In the above syrup, there were also some other active factors which were isolated.) Repeated crystallizations from absolute ethyl alcohol gave colorless needles, m.p. 191-193° (corrected). This active crystalline substance is a neutral material, soluble in alcohol,

benzene, chloroform and water, but insoluble in ethyl ether and petroleum ether Analytical data of this substance is as follows: Anal. Calcd. for $C_{10}H_{16}O_2N_2$:C, 61.20: H, 8.22: N, 14.28: mol wt., 196.24, Found: C, 61.06, 61.18: H. 8.20, 8.22: N, 14.05: mol wt. (by the micro Rast method, dissolved in camphor), 207.19. Therefore, this substance proved to have the empirical formula: $C_{10}H_{16}O_2N_2$. The U.V. spectrum of this substance showed no significant absorption except a strong end absorption. Ninhydrin and biuret reaction were both negative. However, hydrolysis in hydrochloric acid gave proline and valine. Furthermore, the infra-red spectrum of this substance clearly showed the characteristic absorption of diketopiperazine. From these evidences this substance is presumed to be prolyl-valine anhydride.

42. Studies on Homomycin. Part 2. Kiyoshi ISONO, Satoru YAMASHITA, Yoko TOMIYAMA, Saburô SUZUKI and Heiichi SAKAI (Journ. Antibiotics Ser. A **10**, 21–30, 1957)

Homomycin, an antibiotic identical with hygromycin, was isolated from culture filtrates of a new streptomycete, *Streptomyces* noboritoensis. Homomycin, a non-crystalline compound, was purified to its homogeneous state and its crystalline 2, 4-dinitrophenylhydrazone was prepared. Analysis indicated that it is a weak acidic compound with a molecular formula approximating $C_{23}H_{29}NO_{12}$.

43. Studies on the Utilization of Levulinic Acid. Part 1. The Antimicrobial Activities of Levulinic Acid Oxime and Some Related Compounds. Kazuhiko TAKAMIYA (Journ. Antibiotics Ser. A **9**, 218, 1956)

A large amount of levulinic acid has been known to exist in wastes of various agricultural industries, especially in those of glutamic acid and furfural industries. However, the profitable usage of this substance has not yet been reported. During the studies searching for the usage of this acid and the derivatives, the author found that levulinic acid oxime had the antimicrobial effect, selectively against mycobacteria. On the basis of this observation, the author studied the antimicrobial activities of 19 other oximes which had some close structural relationships with levulinic acid oxime, namely acetoxime, methylethylketoneoxime, pyruvic acid oxime, acetoacetic acid oxime, α-ketoglutaric acid oxime, formylpropionic acid oxime, δ-benzylidene and δ-furfurylidene-levulinic acid oxime, β-benzaldoxime, acetophenoxime, glyoxime and so on, and found some relationships between their antibacterial activities and structures. Among them, levulinic acid oxime, acetonylacetone dioxime and acetophenoxime were found to exhibit the selective inhibition against mycobacteria. The existence of γ-isonitroso group and a methylene group adjacent to the carboxyl group of the levulinic acid oxime was suggested to exert the antibacterial activity. Then, γ, ζ-diketosebacinic acid (dilevulinic acid) dioxime synthesized from levulinic acid was found also to be effective aganst mycobacteria.

Antimicrobial activities of 20 substances studied are presented, and the structural relationships with the antimicrobial activity are discussed. Strains tested were: Bacillus subtilis, Sarcina lutea, Escherichia coli, Mycobacterium phlei, Mycobacterium 607, Mycobacterium tuberculosis B.C.G., Penicillium chrysogenum Q 176, Aspergillus niger NRRL 330, Ophioborus myabeanus, Trichophyton purpureum, Candida albicans, Saccharomyces cerevisiae, Tolura utilis, Bacillus hiochi, Neurospora crassa and Piricularia oryzae.

44. Research on the application of microwaves. Part 1. Kin-ichirô SAKAGUCHI, Sôgo OKAMURA and Ryouichi AKAHOSHI (Annual Rep. Eng. Res. Inst. Fac. Eng., Univ. of Tokyo. 15th year **1**, 1–10)

Dielectric characteristics of the various spirits are investigated, and the dielectric constant of the aged spirit is found to be smaller than that of the new spirit at the same alcohol concentration. It may also be expected that the strength of the intermolecular forces will be known by measuring the dielectric constant of the spirits or alcohol aq solutions at microwave frequencies. In order to obtain the aged spirit, effects of the dielectric heating to alcohol aq solutions at microwave frequencies were investigated, and the following results were obtained.

a) Esterification of alcohol aq solutions in liquid-phase is accelerated, and about thirty hours' treatment will correspond to a natural aging for four or five years.
b) Taste and smell of treated solutions are equal to the matured.
c) Dielectric constant of the solution decreases by dielectric heating, and the thirty hours' treatment corresponds to natural aging for three years.

Part 2. Kin-ichirô SAKAGUCHI, Sôgo OKAMURA and Ryouichi AKAHOSHI (Ibid., 16th year No. 2, 1–4)

Dielectric measurement on new distilled spirits and aged ones was carried out at 5–500 MC electric fields.

a) The values of new spirits' dielectric constants at 500 MC electric field are smaller than at 5 MC. It shows the strong molecular interaction between water and ethanol molecules.

b) Aged spirits have pretty smaller dielectric constants compared with new ones which have same ethanol concentration at 500 MC electric field. Decrease of dielectricity shows that orientation of ethanol molecules are hindered by intermolecular forces from neighbouring molecules or electrolyte-ions. At electric fields of microwave frequency these phenomena might be found more distinctly. Therefore it may be possible to know the aging degree of whisky or other distilled spirits from their dielectricity at microwave frequencies.

45. Permentative production of l-glutamic acid from α-ketoglutaric acid and ammonium salt. Sin-ichirô ÔTSUKA, Hideyuki YAZAKI, Hirohiko NAGASE and Kin-ichirô SAKAGUCHI (Bull. Agr. Chem. Soc. Japan **21**, 1, 69–70, 1957; Journ. Gen. Appl. Microbiol. **3**, 35–53, 1957; Hakkôkyôkaishi **15**, 2, 1957)

Many microorganisms which are able to grow in the medium containing α-ketoglutarate and ammonium chloride, and do accumulate L-glutamate in the medium were isolated. Some properties of a strain of *Pseudomonas ovalis* which showed the highest level of L-glutamate accumulation were studied. When the heavy cell suspensions of this organism were incubated in the medium anaerobically and pH of the medium was maintained neutral or slightly alkaline, within 24 to 30 hrs., about 30 μM L-glutamate were accumulated in the medium. The enzymological studies suggested that L-glutamate was formed mainly though the reductive amination of α-ketoglutarate in our organism used.

46. Studies ou the color of conidia in koji-molds. Part 1. The formation of green conidia by culture filtrates, mycelial mat extracts and culture condition. Yoshimasa TAKAGI (Journ. Agr. Chem. Soc. Japan **31**, 12–17, 1957)

Using genetically blocked yellow mutant of Asp. sojae 260, some environmental conditions which favor the conidial color change from yellow to green were investigated.
mate per ml, an amount corresponding to 60% of the initially added α-ketoglutarate,

1. In the presence of culture filtrate or mycelial mat extract of other fungi, the yellow conidia of the Y_1 strain changed their color into green.
2. With the presence of copper and halogen ions such as chlorine, bromine and iodine, the yellow color changed almost completely to green. The color change was proved to occur only in yellow mutants of *Asp. sojas* and *Asp. oryzae*.
3. The green conidia thus obtained returned to yellow when they were transplanted to the ordinary media. It is apparent, therefore, that the color change was merely a physiological modification.
4. For the development of green color, the original green strain required copper ion, but the yellow mutant required both copper and halogen ions.
5. The relationship between yellow and green pigments is discussed.

III. Agricultural Economics

Abstract Nos. 47—48

47. A concideration on capital rationing. Yuzuru ITO (Annals Soc. Res. Coopera tive—Management and Organization of Cooperative—**1**, 18–38, 1957)

According to Professor A.G. Hart's definition, capital rationing will be said to exist when a firm is in some way prevented from borrowing unlimited amounts at the prices and interest rates in effect. It is effective when the limits set, fall short of the volume of dealings the firm would choose to carry on, if free. Capital rationing is the characteristic phenomenon under the present capitalistic economy, and the situation is severe in the case of small-size farmers.

The concept "capital rationing" as a tool of economic analysis was invented by A. G. Hart and M. Kalecki and was introduced to the spheres of agricultural economics by the so-called Schultzians (this nomination is due to W. O. Jones), T. W. Schultz, G. Johnson, E. O. Heady and others. Schultzians distinguished two types of rationing, external rationing and internal rationing. The former is proper capital rationing, and the latter is risk aversion. From the view-point of Agricultural Finance, external rationing is more important. The degree of capital intensity of Japanese agriculture is restricted because of the existence of such a phenomenon. By what reasons does rationing exist? We can see two reasons. One is the response of lending firms to this proper uncertainty. The other is institutional regulation of interest rate.

Interest rate is a increasing function of loan. Theoretically, this function is a

continuous function. But, in reality, because of too expensiveness and difficulty of accurate measurement of the risk element, interest rate charged by lending firm is steppedly a increasing function of loan. Thus, supply curve of capital is stepped, and demand curve for capital is continuous, and then we shall find the possibility of existence of a gap between marginal efficiency of capital and the rate of interest. But in this stage, such a gap should not be so large as the actual one. We can add a next facter, institutional regulation of interest rate. In Japan, we have now the Extraordinary Interest Rate Adjustment Law (Rinji Kinri Chôsei Hô) under which we have the upper limit of interest rate charged by orthodoxical lending firm. Agricultural Credit Cooperatives are not regulated by this law as far as loan interest rate is concerned. But, because of the raison d'être of Agricultural Credit Cooperatives, they have self-imposed maximum rate. Interest rate is thus institutionalized, and ceases to be a parametric variable. So we have small-sized businessmen and farmers who are not able to obtain all of the capital funds which they might desire at current interest rate from banks and cooperatives.

Unorganized lender has no such legal restriction, and an unsatisfied borrower obtains the capital from these lenders at the more unfavorable terms. Even in case of production credit, Japanese farmer borrows more than 30% of total production loan from these unorganized lenders. And banks and cooperatives which receive fund from farmer as deposit invest their fund to non-agricultural sector, in which capital is more liquid than in agriculture. Government and government sponsored institutions make loans and subsidized agriculture by low rate of interest and other favorable terms in order to promote agricultural productivity. The economic interpretation of the activity of government and government sponsered institutions can be explained from this point.

48. **Equibibrium analysis of the Cooperative association.** Kimio KINOSHITA (Annals Soc. Res. Cooperative—Management and Organization of Cooperative—**1**, 219–263, 1957)

Introduction. This study attempts to develop, on the basis of the theory of economic equilibrium, a reasonable and complete economic structure of the cooperative association. First of all, it is most necessary for this attempt to clearly define the basic concepts about the cooperative association, which have remained anbiguous in many literature. First, what is cooperation? A rational definition of this concept would be as follows: The cooperative association is an economic institution organized by small producers or workers with their own common plant and through which a part of their individual economic activity is jointly operated so as to get the maximum possible benefit on the basis of mutual co-operation and the economy of large scale production. This definition emphasizes two aspects: 1) organization of the cooperative, and 2) cooperative activity. As will be seen later, these two aspects form the framework of our theory of the cooperative and the other conditions of equilibrium governing cooperative activity. Secondly, we should know the theoretical basis of the different kinds of cooperatives. A theoretical classification of various cooperative associations must be made from the identity of the economic system possessed by each one of them, and not by the similarity of their forms. From this view point, we can classify cooperatives into two groups, viz. producers' cooperatives and consumers' cooperatives. Producers' Cooperatives could be further classified into sales coopera-

tives, purchasing cooperatives, credit cooperatives (for producers) and productoin cooperatives (of workers). Similar sub-classification for consumers' cooperatives is also possible, but it is insignificant. The five types mentioned above may be taken as covering the whole field of cooperative associations, as will be shown in our later analysis. For further classification of our theory, we shall distinguish between a single activity of the cooperative and its multiple activities. Single cativity may be defined here as the cooperative activity, treating of only one commodity or providing only one kind of service and multiple activities as activities involving the treatment of two or more commodities and provision of two or more services. It is pertinent to formulate some economic models of cooperatives and examine them both analytically and mathematically in order to develop a strict theory.

Analysis: A) Theory of single activity in the cooperative.

a) Sales cooperative: This cooperative specialized in selling the produce of the members of the association. The productive activities of the members are carried out seperately elsewhere. Now, let us suppose that a sales cooperative is organized in a given region, then the 'types of productive units' of its members in that region will be fixed, say by n types. To understand precisely this vague concept of the 'types of productive units', let us indicate here the total cost functions of each individual unit in this region by $\pi_1(x_1), \ldots, \pi_n(x_n)$, where $x_1, \ldots, x_n$ stand for quantities of the produce supplied by each member. Let the number of participating members of the π_i type be represented by m_i, the total number of members in all types by M, and total quantities supplied by all members to the cooperative by ξ. Then we can write $M=m_1+\cdots\cdots+m_n$, and $\xi=m_1x_1+\cdots\cdots+m_nx_n$. Furthermore, let us suppose that the cooperative has a sphere of operation represented by r and then members participating will be a function of the sphere r. So that we can write $m_i=\phi_i(r)$. Next, let the average cost of cooperative plant be represented by K, then it consists of two kinds of cost: one is transport cost which usually will be expressed as a function of transport distance, say as $K_1(r)$, the other is general cost (rest of the cooperative cost) which is regarded as a function of only ξ, say as $K_2(\xi)$. So that we can write $K=K_1(r)+K_2(\xi)$, or more generally $K=K(\xi, r)$. Thus, under the constant market price (p), we have a general economic model of the sales cooperative as follows:

$$\begin{cases} G_i=px_i-\pi_i(x_i)-x_iK(\xi, r) \qquad (i=1, 2, \cdots, n) \\ \xi=x_1\phi_1(r)+\cdots+x_n\phi_n(r) \end{cases}$$

Where G_i represents the net benefit of the i type member. It should be noticed that this model, in general, gives us no equilibrium from the view point of maximizing the economic return to each participating member. For n+2 independent equations will be derived for n+1 unknown valiables $x_1, \ldots, x_n$ r.

1) Equilibrium conditions in the case of a fixed number of members, (*constant* r). The following assumption would be the most rational postulate governing the cooperative activity: i) maximazing the sum of each participating member's benefit, viz. $d\sum m_iG_i=0$ ($m_i=\phi_i(r)=$ constant) or alternatively, ii) conjectural variations of any i type member (represented by $\left.\frac{\delta x_j}{\delta v_i}\right)$ being given, viz. $\frac{\delta x_j}{\delta x_i}=\frac{x_j}{x_i}$. ($j=1,2,\cdots\cdot n$). These alternative postulates give the following same result.

$$\pi_i'(x_i)+\left\{K(\xi, r)+\xi \frac{\partial K}{\partial \xi}\right\}=p \qquad (i=1, 2, \cdots, n)$$

The equilibrium equations, if expressed in economic terms, will be that the sum total of the marginal cost of the participating individual plant and the marginal cost of the cooperative plant must be equal to the market price.

2) Optimum size of organization in the case of variable members (variable r): The previous equations explained that the quantity of output (x_i) produced by each member is a function of r which was taken as a parameter. Consequently each member's benefit G_i was also a function of r. At what value of r could the most beneficial condition be expected? Expansion of the cooperative sphere is possible and rational only if it gives the old existing members increasing benefits. Therefore, the most beneficial condition will be achieved at the limit of the expansion permitted. This can be expressed by $\sum\phi_i(r)\frac{dG_i}{dr}=0$. From this, we obtain the following result:

$$\frac{\partial K}{\partial r}+\frac{\partial K}{\partial \xi}\frac{\partial \xi}{\partial r}=0.$$

In other words, by $K=K_1(r)+K_2(\xi)$, $\quad K'_1=-K'_2(\xi)\frac{\partial \xi}{\partial r}$.

This also explains that the rate of change in the increasing average transport cost must be equal to the rate of change in the decreasing average general cost, both with respect to the distance (r).

3) The cooperative monopoly: In this case, a price at which a cooperative sells is not constant, but is a function of the quantities supplied by the cooperative to the market. It will be expressed by $P(\xi)$. So that, in the case of the cooperative monopoly, our previous economic model is rewritten as follows:

$$\begin{cases} G_i=P(\xi)\cdot x_i-\pi_i(x_i)-x_iK(\xi, r) \quad (i=1, 2, \cdots, n) \\ \xi=x_1\phi_1(r)+\cdots+x_n\phi_n(r) \end{cases}$$

By the same token, the equilibrium conditions while r is constant will be: $\pi_i'(x_i)+\left\{K(\xi, r)+\xi\frac{\partial K}{\partial r}\right\}=P(\xi)+\xi P'(\xi)$ $(i=1, 2, \cdots\cdots, n)$, where the right side of the equation explains the marginal revenue of the monopolistic cooperative plant. And optimum size of organization, where r is variable, will be: $\frac{\partial K}{\partial r}+\frac{\partial K}{\partial \xi}\frac{\partial \xi}{\partial r}=P'(\xi)\frac{\partial \xi}{\partial r}$ or, in other words, $K_1'(r)+K_2'(\xi)\frac{\partial \xi}{\partial r}=P'(\xi)\frac{\partial \xi}{\partial r}$ where the right side explains a rate of change in the decreasing average cooperative revenue (or price) with respect to the expanded distance (r).

Note: dairying cooperative and other kinds of processing cooperatives belong theoretically to the same category as the sales cooperative mentioned above.

b. Purchasing Cooperative: Since our main discussions of the sales cooperative will be adapted to other types of cooperatives, we shall only give the compact mathematical formulations for them without economic explanations.

Now, let v_{1i}=qnantities of the 1st factor distributed by the cooperative to each i type member. v=sum total of quantities of the first factor distributed by the cooperative to all its members.

v_{ki}=quantities of the k factor purchased by the i type member outside the cooperative (e.g. merchants). $(k=2, \cdots, s.)$

w_1 =price paid by the cooperative for purchasing the 1st factor from the market.

w_k =price of the k factor purchased by members outside the cooperetive.

p=selling price of each member's output outside the cooperative.

f_i=production function of the i type.

K_1=average transport cost in the cooperative.

K_2=average general cost in the cooperative (excluding cost price and transport cost).

K =average total cost in the cooperative.

Let the rest of the notations be as before

Then, $$K(v, r)=W_1+K_1(r)+K_2(v)$$

Model:
$$\begin{cases} x_i=f_i(v_{1i}, \cdots, u_{si}) \\ G_i=px_i-\{K(v, r)\cdot v_{1i}+w_2v_2+\cdots+w_sv_{si}\} \quad (i=1, 2, \cdots, n) \\ v=v_{11}\phi_1(r)+\cdots+v_{1n}\phi_n(r) \end{cases}$$

1) Equilibrium conditions when r is constant. By our previous postulate

$$d\sum m_iG_i=0, \quad \text{or} \quad \frac{\partial v_{1j}}{\partial v_{1i}}=\frac{v_{1j}}{v_{1i}}, \quad \text{we have}$$

$$p\frac{\partial f_i}{\partial v_{1i}}=K(v, r)+v\frac{\partial K}{\partial v} \quad (i=1, 2, \cdots, n), \qquad p\frac{\partial f_i}{\partial v_{ji}}=w_j \quad (i=1, 2, \cdots, n,\ j=2\cdots, s)$$

i. e., $$\frac{\partial f_i}{\partial v_{1i}}\Big/\left\{K(v, r)+v\frac{\partial K}{\partial v}\right\}=\frac{\partial f_i}{\partial v_{2i}}\Big/w_2=\cdots=\frac{\partial f_i}{\partial f_{si}}\Big/w_s=\frac{1}{p} \quad (i=1, 2, \cdots, n)$$

2) Optimum size of organization when r is variable. According to our postulate

$$\Sigma\phi_i(r)\frac{dG_i}{dr}=0, \quad \text{we get}$$

$$\frac{\partial K}{\partial r}+\frac{\partial K}{\partial v}\frac{\partial v}{\partial r}=0, \quad \text{or in other words} \quad K_1'(r)=-K_2'(v)\frac{\partial v}{\partial r}.$$

3) Monopsonistic equilibrium condition when r is constant, considering $K=W_1(v)+K_1(v, r)$, will be

$$\begin{cases} p\dfrac{\partial f_i}{\partial v_{1i}}=\{W_1(v)+vW_1'(v)\}+\left\{K_1(v, r)+v\dfrac{\partial K_1}{\partial v}\right\} \quad (i=1, 2, \cdots, n) \\ p\dfrac{\partial f_i}{\partial v_{ji}}=W_j \quad (j=2, 3, \cdots, s;\ i=1, 2, \cdots, n) \end{cases}$$

4) Monoposonistic optimum size when r is variable, will be

$$\frac{\partial K_1}{\partial r}+\frac{\partial K_1}{\partial v}\frac{\partial v}{\partial r}+W_1'(v)\frac{\partial v}{\partial r}=0, \qquad \left(\text{or } K_1(r)+K_2(v)\frac{\partial v}{\partial r}+W_1'(v)\frac{\partial v}{\partial r}=0\right)$$

Note: Many kinds of the service cooperatives belong theoretically to the same category as the purchasing cooperative mentioned above.

c. Consumers' Cooperative.

Let x_{1i}=quantities of the 1st consumers' good or service supplied by the cooperative to the i type member.

ξ= sum total quantities of the 1st good or service supplied to all members by the cooperative.

x_{ji}=quantities of the j good or service purchased by the i type member from outside. $(j=2, \cdots, s)$

p_1=cost price of the 1st consumers' good or service purchased by the cooperative from the market.

p_j=price of the j good or service purchase by members from outside.

u_i, f_i=utility function of the i type.

M_i=income used for consumption by the i type member. The other notations remain as before. Total average cost of the cooperative (K) will be

$$K(\xi, r)=p_1+K_1(r)+K_2(\xi).$$

Then a model of consumers' cooperative could be formulated as follows:

$$\begin{cases} K(\xi, r)\cdot x_{1i}+p_2x_{2i}+\cdots+p_sx_{si}=M_i & (i=1, 2, \cdots, n) \\ u_i=f_i(x_{1i}, \cdots, x_{si}) & (i=1, 2, \cdots, n) \\ \xi=x_{11}\phi_1(r)+\cdots+x_{1n}\phi_n(r) \end{cases}$$

1) Equilibrium conditions when r is constant: From our postulate $d\sum m_iG_i=0$

or $\frac{\delta x_{1j}}{\delta x_{1i}}=\frac{x_{1j}}{x_{1i}}$, we get

$$\frac{\partial f_i}{\partial x_{1i}}\Big/\left\{K(\xi, r)+\xi\frac{\partial K}{\partial \xi}\right\}=\frac{\partial f_i}{\partial x_{2i}}\Big/p_2=\cdots=\frac{\partial f_i}{\partial x_{si}}\Big/p_s \qquad (i=1, 2, \cdots, n)$$

2) Optimum size of organization, according to our postulate

$\sum\phi_i(r)\frac{dG_i}{dr}=0$, will be $\frac{\partial K}{\partial r}+\frac{\partial K}{\partial \xi}\frac{\partial \xi}{\partial v}=0$ or in other words $K_1'(r)=-K_2'(r)\frac{\partial \xi}{\partial r}$

d. Credit cooperative

Let l_i=amount of credit supplied by the cooperative to the i type member.

l=sum total amounts of credit made available to all members from the cooperative funds.

k_i=amount of the private funds owned by the i member (assumed to be constant).

j=average rate of interest paid by the cooperative for its own saving and its borrowing from outside (for l).

R_1=special rate for l (i.e. a rate that is to be paid to attract extra savings deposits.)

R_2=rate of all members' risk-premium for l.

K=general rate for l. (excluding the above cost R_1 and R_2).

R=sum total of all cost in the cooperative in terms of l.

We could obtain the following relationship: $R=j+R_1(l, r)+R_2(r)+K(l)$. Then the model of credit cooperative would be formulated as follows:

$$\begin{cases} G_i=px_i-\pi_i(x_i)-l_iR(l, r) & (i=1, 2, \cdots, n) \\ l=l_1\phi_1(r)+\cdots+l_n\phi_n(r) \\ l_i+k_i=\pi_i(x_i) \end{cases}$$

1) Equilibrium conditions in the case of the fixed number of members (constant r). From our pastulate $d\sum m_iG_i$ or $\frac{\delta x_k}{\delta x_i}=\frac{x_k}{x_i}\left(\text{or } \frac{\delta l_k}{\delta l_i}=\frac{l_k}{l_i}\right)$ $(k=1, 2, \cdots, n)$, we can derive

$$\frac{p-\pi_i'(x_i)}{\pi_i'(x_i)}=R+l\frac{\partial R}{\partial l} \qquad (i=1, 2, \cdots, n)$$

This explains that marginal rate of return of each member must be equal to marginal rate of cost (or interest) on the funds supplied by cooperative.

2) Optimum size of organization; according to our postulate $d\sum\phi_i(r)\frac{dG_i}{dr}=0$, will be $\frac{\partial R}{\partial r}+\frac{\partial R}{\partial l}\frac{\partial l}{\partial r}=0$ or in other words $\left(\frac{\partial R_1}{\partial r}+\frac{\partial R_1}{\partial l}\frac{\partial l}{\partial r}\right)+R_2'(r)=-R'(l)\frac{\partial l}{\partial r}$.

B. The theory of multiple activities in the cooperative. The multiple activities of the cooperative must be analysed on the basis of the theory of joint production. Suppose that the cooperative is handling many commodities and services, their quantities represented respectively as $\xi_1, \ldots, \xi_q$. Then its total cost II and its average cost K are both functions of $\xi_1, \ldots, \xi_q$. The relationship between them may be written as follows:

$$\Pi(\xi_1, \cdots, \xi_q)=\xi_1 K_1(\xi_1, \cdots, \xi_q)+\cdots+\xi_q K_q(\xi_1, \cdots, \xi_q).$$

If we keep the above relationship in mind, we can proceed with our analysis in this field in the same way as our previous discussion. Though there are many kinds and types of multiple cooperatives, they are merely combinations between the basic ones mentioned earlier. Therefore, a few examples will be shown here.

1) *Multiple activities of the sales cooperative*: A model would be as follows.

$$\begin{cases} G_i=(p_1x_{1i}+\cdots+p_qx_{qi}+\cdots+p_sx_{si})-\pi_i(x_{1i},\cdots, x_{si})-\{x_{1i}K_1(\xi_1,\cdots,\xi_q,r)+\cdots \\ \quad +x_{qi}K_q(\xi_1, \cdots \xi_q.r)\} \qquad (i=1.2,\cdots n) \\ \xi_1=x_{11}\phi_1(r)+\cdots+x_{1n}\phi_n(r) \\ \xi_q=x_{q1}\phi_1(r)+\cdots+x_{qn}\phi_n(r) \end{cases}$$

Equilibrium conditions when r is constant, will be

$$\begin{cases} p_j-\frac{\partial \pi_i}{\partial x_{ji}}-K_j-\left\{\xi_1\frac{\partial K_1}{\partial \xi_j}+\cdots+\xi_q\frac{\partial K_q}{\partial \xi_j}\right\}=0 \quad (j=1, 2, \cdots, q;\ i=1, 2, \cdots, n) \\ p_k-\frac{\partial \pi_i}{\partial x_{kj}}=0 \qquad (k=q+1, \cdots, s;\ i=1, 2, \cdots, n) \end{cases}$$

or $\frac{\partial \pi_i}{\partial x_{ji}}+\frac{\partial \Pi}{\partial \xi_j}=p_j$, $\quad \frac{\partial \pi_i}{\partial x_{ki}}=p_k \qquad (j=1, 2, \cdots q;\ k=q+1, \cdots, s;\ i=1, 2, \cdots, n)$

Optimum size of the cooperative organization (variable r) will be

$$\xi_1\left(\frac{\partial K_1}{\partial \xi_1}\frac{\partial \xi_1}{\partial r}+\cdots+\frac{\partial K_1}{\partial \xi_q}\frac{\partial \xi_q}{\partial r}\right)+\cdots+\xi_q\left(\frac{\partial K_q}{\partial \xi_1}\frac{\partial \xi_1}{\partial r}+\cdots+\frac{\partial K_q}{\partial \xi_q}\frac{\partial \xi_q}{\partial r}\right)$$
$$+\left(\xi_1\frac{\partial K_1}{\partial r}+\cdots+\xi_q\frac{\partial K_q}{\partial r}\right)=0$$

2) *Multiple activities of the sales and credit cooperative.*

Model:
$$\begin{cases} G_i=(p_1x_{1i}+\cdots+p_qx_{qi}+\cdots p_sx_{si})-\pi_i(x_{1i}, \cdots, x_{si})-(x_{1i}+\cdots+x_{qi})K(\xi, l, r.) \\ \qquad -l_iR(\xi, l, r) \\ \xi=\xi_1+\cdots+\xi_q \\ \xi_1=x_{11}\phi_1(r)+\cdots+x_{1n}\phi_n(r) \\ \xi_q=x_{q1}\phi_1(r)+\cdots+q_{qn}\phi_n(r) \\ l=l_1\phi_1(r)+\cdots+l_n\phi_n(r) \\ l_i+k_i=\pi_i(x_{1i}, \cdots, x_{si}) \end{cases}$$

Equilibrium conditions when r is constant will be

$$\begin{cases} \left\{p_j-\left(\frac{\partial \pi_i}{\partial x_{ji}}+\frac{\partial \Pi}{\partial \xi}\right)\right\} / \frac{\partial \Pi_i}{\partial x_{ji}}=\frac{\partial \Pi}{\partial l} \qquad (j=1, 2, \cdots, q;\ i=1, 2, \cdots, n) \\ \left(p_s-\frac{\partial \pi_i}{\partial x_{si}}\right) / \frac{\partial \pi_i}{\partial x_{si}}=\frac{\partial \Pi}{\partial l} \qquad (s=q+1, \cdots, s;\ i=1, 2, \cdots, n) \end{cases}$$

where $\Pi(\xi, l, r)=\xi K(\xi, l, r)+lR(\xi, l, r)$

Optimum size of the cooperative organization with variable r.

$$\xi\left(\frac{\partial K}{\partial \xi}\ \frac{\partial \xi}{\partial r}+\frac{\partial K}{\partial l}\ \frac{\partial l}{\partial r}\right)+l\left(\frac{\partial R}{\partial \xi}\ \frac{\partial \xi}{\partial r}+\frac{\partial R}{\partial l}\ \frac{\partial l}{\partial r}\right)+\left(\xi\frac{\partial K}{\partial r}+l\frac{\partial R}{\partial r}\right)=0$$

We could proceed further with our analysis of optimum multiplicity in the cooperative. But such analysis being complicated is omitted here. However, it is necessary for us to add a few considerations about the capital of the cooperative so as to complete our theory. More complete cost function of the cooperative must be expressed by $K(\xi_1, \ldots, \xi_t, r, C)$, where subscript t represents any t kind of multiple activity and C represents the capital of cooperative. We could say in conclusion that our ealier theory remains unchanged even if the short-rum cost function is replaced by the long-rum cost function.

IV. Agricultural Engineering

Abstract Nos. 49—57

49. The estimation of runoff based on rainfall data for the Dainichi River basin. Shozo NOGUCHI (Journ. of the power and weather coordinating comittee, Jap. Ser. 2, Vol. 7 No. 3, 7, 142–144, 1957)

The Dainichi River catchment which is situated in southern Awaji is almost entirely mountainious. The catchment area is 395 ha. and now a irrigation reservoir is under construction by Hyogo Prefecture.

The relations between single rainfall and runoff coefficient or intensity of rainfall derived from observed records are as follow.

Date	Precipitations (mm)		Surface Runoff (mm)	Runoff Coefficient C	Max. Intensity of rainfall for 1 hr. (mm/hr)
July 30, 1954	(1)	99.2	80.4	0.81	19.7
	(2)	98.6	72.8	0.74	20.0
Sept. 7, 1954	(1)	193.3	153.6	0.80	30.0
	(2)	191.6	146.8	0.77	25.0
June 18, 1955	(1)	110.0	80.9	0.73	20.4
	(2)	102.6	72.8	0.67	20.4

Remarks; (1), (2) are Number of catchment. Area of (1)=295 ha
Area of (2)=100 ha

With the present state of knowledge for this catchment, the proper value for the coefficient C is considered as follows:

When the maximum intensity of rainfall for one hour is 20-30 mm, the proper value for C is 0.67-0.81, but if a higher rate of rainfall occurs, a larger value for C has to be selected for such a locality.

50. On the annual change of hardness of paddy-soils. Fusanobu SHOJI and others (Journ. Agr. Machin. Soc. Jap. **18** [4], 129–132, 1957)

Hardness or ease of the farming work considerably depends upon the resistances of the soil. Therefore, the authors surveyed these resistances for a year at 3 paddy fields to observe their annual change, using soil-hardness (resistance of penetration into soil by plumbing bob) as its indicator.

Results obtained show that the hardness of paddy-soil has distinguished conditions at 3 different stages in a year, that is to say, irrigated period, drained period, and non-irrigated period. In some paddy fields where after crops are cultivated, the soil hardness shows almost the same tendency as the upland farm during its cultivation.

51. Studies on the mole-drain. Part 1. Fusanobu SHOJI and others (Journ. Agr. Eng. Jap. **25** [1], 6–11, 1957)

The authors investigated on the mole-drain at two prefectures, Akita and Saga, where the use of mole-drainage is comparatively popular, and distinguished the differences between the two systems which are commonly used in these two prefectures, concerning the machines and implements for mole-drain, their operation, the arrangements of drain, its durability and effect of drainage.

As far as the operation system of drainage, the method used in Saga is more intensive than that of Akita, in spite of shallower depth and narrower intervals of each drain. This is because of having relief well and more complete protection of outlets. However, the implements used in Saga prefecture have almost not been improved since Okayama's model, 20 years ago. On the contrary, mole-drainer and winch used in Akita are improved in details, so that they have better performance.

The authors determined that these were due to the differences of the soil quality between the two districts, which influenced the intensity of draught resistance of the mole-drainer, so that there is this relative difficulty in the operation.

52. Studies on the mechanical application of aqueous ammonia or mixed liquid fertilizer as basal dressing for lowland rice. Fusanobu SHOJI and others (Rept. Sci. Res. of Education Ministry **41**, 10–38, 1957)

The authors designed and manufactured for trial 3 models of fertilizing machines to apply liquid manure by mechanical means. Using these models respectively, they also proceeded cultivation tests of lowland rice in paddy field, examined the distribution of ammonia in the soil and investigated the growth of rice plant and yield.

Each machine is one horse drawn type. The first model has a driving wheel with spike-shaped lugs, and 6 tines and nozzles, with which we can accomplish a deep layer application of fertilizer satisfactorily. The method of mechanical application by the first model was generally good, but its body was too heavy. Then, we adopted a rotary harrow as the main body of the second model, to which is attached

a manure applicator, but we had unsatisfactory results, because the driving of the gear pump was not smooth, the latter fault being due ot the slippage of the rotary disc. The third model is a combination of the good points of the first and the second models, and we could obtain almost satisfactory results at its mechanism.

53. On the improvement of the quality of salt by addition of manganic-salts. The effect of polyhydric alcohols. Jiro SUGI and others (Bull. of Salt Sci. Jap. **11** [4], 198–203, 1957)

In the previous paper, we reported that salt of good quality is produced by concentrating the brine and simultaneously adding small quantities of Mn-salt and surface active agents such as solvitan-ester of fatty acid. In this report, we explain that the addition of small quantities of the polyhydric-alcohols such as Sobitol, Mannitol, or Glycerol, with Mn-salts and the surface active-agents is effective for preventing the occlusion of Iron-compounds.

54. On the kinetic capillarity. Jiro SUGI and others (Sci. Papers of Central Res. Inst. Japan Monopoly Corporation, **98**, 1–11, 1957)

The relation between capillary mechanism and capillary chemistry in the solid-liquid phase, in the filter paper, was investigated. Following conclusions were obtained.

1) The velocity of capillary rise, showed a significant change, at a height equal to 30% of maximum capillary height (H. max.).

2) With the rise up to 18% of H. max, the partial velocity of the solute and solvent are different. Due to this difference, the concentration showed a regular change, by the partition theory of solution.

But on standing, from a height of 18% H. max to 30% H. max, due to diffusion, the concentration of solution decreased in height. With the rise up to 30% of H. max, due to adsorption, the concentration showed again a change and increased in height.

55. Studies on characteristics of salt, sea water, brine and bittern. Part 1. On the pH of sea water, brine and bittern (1). Change of pH by adding Magnesium Hydroxide or other Alkalis. Jiro SUGI and others (Sci. Papers of Central Res. Inst. Japan Monopoly Corporation, **98**, 62–70, 1957)

For the purpose of corrosion prevention in salt making, we intended to neutralize the acid in brine or bitter by adding Magnesium Hydroxide or Calcium Carbonate. The following results were obtained.

1) The pH of brine or bittern is adjusted effectively by the addition of Magnesium Hydroxide. For example, pH value were changed from 6.05 to 7.20 by the addition of 0.5 g of that per 100 ml of liquid.

2) Addition of Calcium Carbonate is not effective.

3) Neutralization curve is plotted with Sodium Hydroxide, and the effect of addition of Magnesium Hydroxide is discussed.

56. Studies on oceanic salts. Part 1. Double salts crystallized from the system "Na-K-Mg-Cl-SO_4-H_2O". Jiro SUGI and others (Sci. Papers of Central Res. Inst. Japan Monopoly Corporation, **98**. 71–81, 1957)

The double salts crystallized from the system "Na-K-Mg-Cl-SO_4H_2O" are nine, namely astrakanite, carnallite, glaserite, kainite, langbeinite, leonite, loeweit, schoenite and vanthoffite.

These 9 double salts are synthetized artificially, microphotographed and the powder x-ray diffraction data are taken by the Geiger counter x-ray diffractometer, using Cu K_α radiation. In comparison with the A.S.T.M. data, they were in good agreement for langbeinite, but for astrakanite and glaserite, some differences were found as regards the strongest peak and the largest d spacing.

Part 2. X-ray analysis of Magnesium Sulfate Hydrates. Jiro SUGI and others (Ibid., **98**, 82–87, 1957)

8 $MgSO_4$-Hydrates among 12 hydrates which crystallized from the system "$MgSO_4$-H_2O", namely $MgSO_4 \cdot 7H_2O$ (1), $MgSO_1 \cdot 6H_2O$ (1), $MgSO_4 \cdot 5H_2O$, $MgSO_4 \cdot 4H_2O$, $MgSO_4 \cdot 3H_2O$, $MgSO_4 \cdot 2H_2O$, $MgSO_4 \cdot H_2O$ and $MgSO_4$, are synthetized artificially, and the powder x-ray diffraction data are taken by the Geiger counter diffractometer, using Cu K_α radiation.

By the results of this research, it was found that $MgS0_4$ $3H_2O$ was actually the mixture of $MgSO_4 \cdot 4H_2O$ and $MgSO_4 \cdot 2H_2O \cdot$

57. The electric concentration of sea water by the use of ion exchange membranes. Part 1. Concentration process of sea water with the passage of current. Jiro SUGI and others (Sci. Papers of Central Res. Inst. Japan Monopoly Corporation, **98**, 88–94, 1957)

Employing a 5-compartment cell, concentration process of sea water and brine with the passage of current was studied. The results are as follows:

(1) Sea water is concentrated to 16°Bé in a short time and finally to 29°Bé.

(2) Transfer ion and water is increased, but current efficiency is decreased in proportion to the quantity of electricity.

(3) With the concentration of the brine, the permselectivity of ion exchange membranes becomes low and then the effect of electrolytic concentration is down. The amount of industrial production of brine and the electric power of concentration was estimated on the basis of the upper result.

V. Fisheries

Abstract Nos. 68—93

58. Differences on the frequency of transfer of fishes among several kinds of colours for under-water fencing net. Yoshio HIYAMA, Takaya KUSAKA and Keikichi KONDO (Bull. Jap. Soc. Sci. Fish. 22, 598–601, 1957)

This experiment regarding influence of colours of fish net, was performed in order to observe the frequency of transfer of fishes over several models of fencing net in the center of a tank. The tank is of wood painted white inside, 72 cm. long, 52 cm. wide, with a water depth of 20 cm. The fish used were 10 individuals of *Acheilog-*

nathus lanceolate (Yari-tanago) of average total length 4.5 cm. and they were liberated in the tank. As model of under-water fencing nets, 5 tin-plates 52 cm. long and 14 cm. high were painted black, white, red, yellow and blue enamel. The tin-plate as fencing net was kept under water in the center of the tank, leaving a space of 6 cm. between the water surface and the top of the plate.

The number of transfering fishes over the tin-plate were counted during 10 minutes for each colour plate. This was repeated for 29 times during a period of several days. Averages of the frequency of transfer on each colour is obtained. These averages, when compared, show significant difference. In almost all combinations the significance in level was 1 or 5% excepting for combinations of red and yellow, and white and blue. Therefore, the black, red and yellow have less stopping effects against the transfer of fishes. On the other hand, the effects of the white and blue are obviously more effective and these corresponded to a septum of smi-transparent vinyl film which was kept in the tank leaving only a space of 2 cm. over it for the fish to pass through. Also, the effects of the red and yellow corresponded to the same septum which was kept in the water leaving a space of 6 cm.

59. Difference on the frequency of transfer of fishes with different degrees of inclinations of the under-water fencing net. Yoshio HIYAMA, Takaya KUSAKA and Keikichi KONDO (Bull. Jap. Soc. Sci. Fish. **22**, 602–604, 1957)

This experiment on inclinations of a fish net, was done in a water tank to observe the frequency of transfer of fishes over several models of fencing net. The tank was of wood, 72 cm. long, 52 cm. wide, with water 20 cm. in depth, the tank being painted white inside. The fish used were 10 individuals of *Acheilognathus lanceolate* (Yari-tanago) with an average total length of 4.5 cm. and were liberated in the tank. As model of under-water fencing nets, 4 tin-plates painted with white enamel paint were bent at 90, 60, 45 and 30 degrees of facial angle against the horizontal surface and they were kept at a height of 14 cm., keeping a space of 6 cm. between the water surface and the top of plate.

The number of transfering fishes over the tin-plate were counted during 10 minutes for each inclination. This was repeated 10 times during a period of several days. Averages of the frequency of transfer on each angle is obtained. These averages, when compared with each other, show significant differences. In almost all combinations the significance level was 1 or 5% excepting for the combination of 60 and 45 degrees. The 90 degree plate had bore stopping effect than any of the others. Oecreasing the inclination of underwater fencing net has, less stopping effect against the transfer of fishes: instead it accelerates the transfer. Therefore, the authors suggest that attention should be paid to the inclination of the fish net.

60. Two experiments to see the effect of mesh size of nets on driving a school of fish to a certain point. Takaya KUSAKA (Bull. Jap. Soc. Sci. Fish. **22**, 662–667, 1957)

The author conducted fundamental experiments on the effects and principles of fishing methods and gears.

These experiments were carried out by observing the locomotion activity of fish individuals kept in a tank, set for this purpose. The locomotion activity would differ according to the influence created by the environmental condition or model of

fishing gear used.

The experiments were done with 10 goldfish, *Carassius auratus*, of an average total length of 4.0 cm. They were liberated in a wooden tank of 150 cm. long, 26 cm. wide and 8 cm. water depth. For model nets, 8 wooden frames were made and fine cotton thread was stretched vertically on each frame at intervals of 0.75, 1.00, 1.25, 1.50, 2.0, 3.0, 4.0 cm. except the 8th one which was wooden frame without thread as a contrast.

Two methods, namely, "Centralizing method" and "Driving to one side method" were applied here.

The first method is to drive fishes towards the center of tank from either side with two frames of different meshes, each at a driving speed of about 10 cm. per minute. The number of fish which passed through each frame were counted.. This was repeated for twenty times, using the same combination of frames. The total number of fish that passed through the frame to either side was then found out. The same procedure was repeated using all these 8 frames, and in all combinations of two frames, each. The sum of the total values were obtained. For the ratios of the number of passage of fish to either side of tank, the chi-square test of statistics was applied and the result is expressed as percentages of degrees which differ significantly.

The second method is to drive fishes to one side of tank from the other side by one frame with a speed of 10 cm. per minute as the former. When the fishes are driven up to a certain position, the fishes start to turn back and locomote to the other side passing through the frame. The position of the frame from one end of the tank was observed, and the result of 40 such experiments and the efficiency of driving are obtained. The numerical values, so far got, were converted into common logarithm to get their mean values and to compare them. It has been found that a significant difference exists in almost all combinations when examined by the F-table of statistics.

Consequently, the centralizing method is so reliable as to compare directly the difference between two testings and the driving to one side method is advantageous to express sharply the peculiar quality of each testing.

61. Experiments to see the effect of colour on nets by the centralizing method and the driving to one side method. Takaya KUSAKA (Bull. Jap. Soc. Sci. Fish. **22**, 668–673. 1957)

The author has done these experiments contineously for the former report which was carried out for the "Centralizing method" and the "Driving to one side method".

10 goldfish, *Carassius auratus*, of an average total length of 4.0 cm. were liberated in a wooden tank of 150 cm. long, 26 cm. wide and 8 cm. water depth. For model nets of colours, 8 wooden frames were made to be stretched with vinyl tube (dia. 1 mm.) vertically at intervals of 2.0 cm. on each and each frame had a colour of: semi-transparent, yellow, white, green, pink, red, blue and, except the 8th one which had fine white cotton thread.

The centralizing method was repeated 40 times using all these 8 frames, and in all combinations of two frames each. The sum of the total values were obtained and the chi-square test of statistics was applied to it.

The observed values for the driving to one side method were obtained and the efficiency of driving was also obtained. Average values of them had been examined for significant difference by the F-table of statistics.

As regards driving of fishes by the two experiments, the frames of blue, pink and red are obviously more effective than the other frames of white, yellow, semi-transparent and white cotton thread.

As there is existing difference between the human and the fishes on the senses of sight, the visible distance in the water for each colour of cinyl frame was examined.

Consequently, these results and quoting the results obtained from other sources for of the underwater fencing net the two results were compared on the order of effect of colours, as shown in Table. The orders of experiments (b) and (c) showed very close similarity, as if the materials of model nets are of equal effect and both methods are to drive fishes in. Though (a) was done as fencing net in a stationary position, the author had recognized few similarities between the orders of (a) and (d).

Table. Comparison on effects of colours among four experiments

(a) Stopping effects by tin-plates enamel coloured as fencing net: White=Blue≫Yellow>Red≫Black

(b) Driving effects of coloured vinyl frames by the centralizing method: Red≥Blue≥Pink>Green≫White≥White cotton thread≥Yellow>Semi-transparent

(c) Driving effects of coloured vinyl frames by the driving to one side method: Red>Pink≥Blue>Green>White cotton thread≥Semi-transparent>Yellow>White

(d) Order so far visible distances in the water of coloured vinyl frames: Yellow>Blue>White>Pink>Red>White cotton thread>Green>Semi-transparent

62. Experiments to see the different effects of net on driving, several species of fish. Takaya KUSAKA (Bull. Jap. Soc. Sci. Fish. **23**, 1–5, 1957)

The author has done experiments to see different effects of net on driving fish schools of 5 species using "Driving to one side method".

Fish used were 2 *Carassius auratus*, goldfish, of total length 6.5 cm., 2 *Cyprinus carpio*, carp (gold variety), of T.L. 4.5 cm., 2 *Oryzias latipes*, Japanese killifish (gold variety), of T.L. 2.0 cm., 2 *Acheilognathus lanceolata*, common Japanese bitterling of T. L. 6.0 cm. and 1 *Chaenogobius annularis urotaenia*, common goby, in fresh water T.L. 4.5 cm.

Numerical values were observed in the experiment to drive the fishes from one side of tank to other side at a speed of 10 cm. per minute by a frame of width 25 cm. and height 10 cm., on which white vinyl tubes of 1 mm. dia. are vertically stretched at an interval of 2.0 cm. each. When the fishes start to move to the other side through the frame, the position of the frame was observed. Size of the tank was 150 cm. long, 26 cm. wide and 8 cm. water depth, but the length was changed to 60, 80, 100, 120 or 150 cm. as observing conditions, when drivings were made. They were done 30 times in every case, through Aug. 31st—Sept. 5th, 1956, time being 11.00–14.00 and water temperature 21.5–26.0 degree C.

The observed values are obtained and those frequency distributions are expressed in figure; also their mean values with standard deviation are obtained. Moreover, there are obtained degree of effect as ratio of frequency to driven fishes till a certain position by repeating 30 times, and degree of driving effect as percentages on the average driven value of distances in cm. by the tank length at the time when the driving started.

Summarizing the author's consideration, the driving effect is less under the starting length at 60 cm., and is much under the length of over 80 cm.

There is a remarkable difference in driving effects among each fish which, in the case of goldfish and carp are comparatively hard, and in the case of killifish, bitterling and the goby are very easy.

63. Age and growth of Pacific tunas by scale reading. Yukio NOSE, Hiroshi KAWATSU and Yoshio HIYAMA (Collection of Works on Fish. Sci. Jubilee Publication of Prof. I. AMEMIYA, Univ. of Tokyo Press, 701–716, 1957)

The age and growth of three Pacific tunas, albacore, *Germo germo*, yellowfin tuna, *Neothunnus macropterus* and bigeye tuna, *Parathunnus mebachi* were studied based on the ring appearing on the scale.

The fork length at the time of ring formation, l_n (cm.) are as follows,

$l_1=38$, $l_2=49$, $l_3=59$, $l_4=68$, $l_5=78$, $l_6=86$, $l_7=96$ and $l_8=105$ for albacore,

$l_1=52$, $l_2=64$, $l_3=76$, $l_4=88$, $l_5=99$, $l_6=109$, $l_7=119$, $l_8=127$ and $l_9=135$ for yellowfin tuna, and

$l_1=35$, $l_2=49$, $l_3=62$, $l_4=74$, $l_5=85$, $l_6=97$ and $l_7=115$ for bigeye tuna.

The age composition of albacore taken in the main fishing ground between 28° and 40°N in the western Pacific has many age-classes (III-VIII age), but the age compositions in the other areas are towards to older age (VI-VIII age).

Yellowfin tuna examined were all over the VI or VII age-classes.

Our results were compared with that of previous works based on other characters and the results were coincidental to some, but not to all.

Here, we think the ring appearing on the scale of these tunas is availale to age determination and age composition can be discussed by this.

64. Mechanism of utilization of plankton by some fishes. Fujio YASUDA and Yoshio HIYAMA (Rec. Oceanogr. Works Jap. 3, 85–91, 1957)

Discussing the productivity of water, such condition as the concentration of nutrient salt, up-welling movement of water mass, the strength of light for synthesis, the density of plankton and so on, have been usually investigated. However, during the biotic process, the method of plankton utilization by fish is one of the keys for the mechanism of production.

Here, the feeding mechanism of some of the plankton feeders are investigated to see how the plankton is utilized, either indirectly as th food of carnivorous fish or directly as the harvest. As materials to be studied, five important species, commercially fished in large amounts at off shore areas of Japan were utilized. They are "Saba", mackerel, *Scomber japonicus* HOUTTUYN; "Aji", horse mackerel, *Trachurus japonicus* (T & S); "Samma", mackerel pike or skipper, *Cololabis saira* (BREVOORT); "Iwashi", sardine or pilchard, *Sardinia melanosticta* (T & S); and "Katakuchi-iwashi", anchovy, *Engraulis japonica* (HOUTTUYN); and the two minor species "Sappa", *Harengula zunasi* (BLEEKER); "Urume-iwashi", bigeyed sardine or round herring, *Etrumeus micropus* (T & S) were utilized for comparison.

The results obtained are summarized, as follows:

(1) Structure of gill and its filtering mechanims:—Comparing the structure and mesh size formed by the gill rakers of these fishes with each other, it can be said

that mackerel and horse mackerel have the most coarse structure, while sardine and anchovy have the finest structure, and that the mackerel pike is between the two groups.

(2) Size of food in stomach:—By an examination of the stomach contents, it can be said generally that mackerel and horse mackerel take the plankton of larger size and of higher food order, while sardine and anchovy take the smaller ones, and the mackerel pike is between the two groups.

(3) Feeding experiments:—The aquarium experiment to feed mackerel, horse mackerel and anchovy with brine shrimp eggs (*Artemia salina*, 0.18-0.22 mm. in diameter) was done, and examining the stomach we found that the horse mackerel and anchovy took the food but mackerel did not. As the smaller organisms, purely cultured diatom, *Thalassiosira sp.* (0.03 mm. in length) was mixed into the sea water in various concentrations where these fishes were reared. However, since we hardly could find any cells in the stomach, we supposed that they passed through the filtering system of the gill.

(4) Production of plankton feeding fish of the off shore region of Japan:—The production of the off shore regions depends primarily on the co-existance of plankton feeders and the size of the available planktons as food for these species and not on the species that feed on plankton feeders.

65. Up-take of strontium by marine fish from the environment. Yoshio HIYAMA and Ryushi ICHIKAWA (Rec. Oceanogr. Works Jap. 3, 78–84, 1957)

The rearing experiments to see up-take of strontium by fish from the environmental water was investigated. Sr90 concentration in fish tissue (Sr*F) reared in water having Sr90 at a certain concentration and (Sr*E) where already natural strontium existed in concentration (SrE), proved to be decided by the following formula. $Sr^*F/SrF = Sr^*E/SrE$. Getting Sr90 concentration in muscle and bone of fish, Sr*F, by radioassay, the concentration of normal strontium in them, SrF, was calculated by the formula stated above.

SrF of the muscle and bone of common goby reared in 20 l. of water during 7 days was 1.3×10^{-4} and 3.3×10^{-3} mg./g. (wet tissue) respectively. On the other hand, in case of puffer and marine goby reared in 50 l. of water during 6 days, SrF of the former was 4.2×10^{-4} mg./g. in muscle and 2.2×10^{-2} mg./g. in bone and that of the latter was 3.9×10^{-4} mg./g. in muscle and 1.6×10^{-2} mg./g. in bone respectively.

Colume of the water in the former experiment was so small that the replacement of strontium was smaller than the case of latter experiment.

Supposing that Sr:Ca ratio in muscle is the same as in bone which was already obtained by chemical analysis, based upon the calculated figures of SrE in muscle and bone in the second experiment, the fraction of replacement of those elements to the total amount in tissues from environment was culculated. As for muscle, replacement is thought to be complete, but as for bone, it is supposed to be only 1/10 during a week long rearing experiment.

By this sort of biological experiment, we can measure ever faint concentrations of the eldement either in a certain tissue or in any environment, to a lower level, better than usual chemical analysis can do. This sort of radiological bio-assay can be applicable to some other nuclides too, if the experiment is carefully done.

66. New tagging method of fish by radioactive cobalt. Yoshio HIYAMA and Ryushi ICHIKAWA (Symposium on the Study and Application of Radioisotopes, Japanese Council of Atomic Industry, 554–555, 1956)

Tagging methods used generally are separated into two groups. One is the fastening of various plate or ribbon for out side of fish body and another is the insertion of iron piece in the body cavity. The weak point of the former is the high rate of dropping off of the tag and that of the latter is the difficulty in finding out the tag. It is thereason why the authors tried this preliminary experiment using radioactive cobalt.

Gold fishes inserted with glass ample containing 0.1 mc. of cobalt-60 were reared for about half a year. The mortality rate of them was not more than the control group. By this method, the finding out of tagged fishes become greatly easier and the dropping off of the tag does'nt happen in any way.

67. A study of fish scale by radioactive strontium. Ryushi KASAHARA (Symposium on the Study and Application of Radioisotopes, Japanese Council of Atomic Industry, 551–552, 1956)

We have little knowledge about the growth and calcification of fish scale which is very important for the calculation of age by finding the annuli marked on it. In this report, the author studied the deposition ofs trontium-90 in teleost scale by the method of radio-autography because strontium behaves as similar as calcium does in the animal body. The results obtained are as follows:

Strontium-90 deposited remarkably on the outer surface of scale on which the circuli existed and not on the under surface of it. Especially, the marginal part of the covered (basal area and ridges on exposed (apical) area of the scale took more strontium-90 than other area. By the radioautograph of transverse section of scale, it is recognized that strontium-90 entered gradually into the inner part of scale and distributed as shown in Fig. 1. This distribution pattern is quite coincidental with the distribution of calcium salts found by the author stated in other papers already.

Fig. 1. Radioautograph of transverse section of scale
r......radius S......scale
b......blackened area by radiation of Sr90

68. Cultivation of the sea-bass, *Lateolabrax japonicus*, in brackish-water farm ponds, with special reference to the production and food habits of the fish. Shogoro KASAHARA and Yasuo OHSHIMA (Collection of Works on Fish. Sci. Jubilee Publication of Prof. I. AMEMIYA, Univ. of Tokyo Press, 3–10, 1957)

In brackish-water farm ponds that are used for the culture of eel, there lives a lot of small animals such as mysid-shrimps, shrimps and fishes. These small animals, however, are not fed upon by the eels. During the last few years, since 1950, the Atsumi Fish Culture Company has been working successfully in the farm ponds to cultivate the sea-bass which utilizes these small animals as food.

The annual cycle for the production of this fish is begun in early May, with the

planting of the young fish (37 gr. per 100 individuals), which are collected from shallow waters near the ponds. At the end of the year, the ponds are drained and the crops of sea-bass are harvested with other commercial fishes.

Although the yield or the size of fish obtained varies with the amount of natural food available and with the number per acre of the stockbrood, a satisfactory result is, when the pond yields about 38～55 kg. per acre of sea-bass, while the fish grows to the average size of 170 gr. in weight and 20 cm. in body length. The rate of growth, when compared with that of the open sea, was found to be satisfactory. The optimum number of the stock brood to produce annual harvestable crops may be 370～500 per acre in each pond.

Gastric analysis of the stomach contents of sea-bass, taken from ponds, revealed that mysid-shrimps (*Neomysis japonica*) is the principal food through the period May to August, and after that period the fish gradually begins to feed on such larger animals as shrimps, rice-minnows and other small fishes. In every ponds the population of mysid is dense enough to support the growth of sea-bass at its younger stages. Therefore the size of harvestable crops is rather influenced by the amount of the larger food animals which are the principal food of sea-bass in the latter half of the breeding period.

Hence it may be concluded that any management programme for the production of natural food resources, should especially be for the production of larger food animals in order to meet the expection of an increased or continuous production of sea-bass in such controlled waters as farm ponds.

69. Studies on the red tide. Part 1. Summer flowering of *Skeletonema costatum* and Aoshiwo (green tide) in the northern region of Tokyo Bay. Reijiro HIRANO (Collection of Works on Fish. Sci. Jubilee Publication of Prof. I. AMEMIYA, Univ. of Tokyo Press, 407–411, 1957)

In the northern region of Tokyo Bay the red tide occurs frequently from spring to autumn and several different phenomena are involved in these so-called red tides. The present study was designed to explain two of the phenomena which occur in summer: one is the summer flowering of *Skeletonema costatum* and the other is called Aoshiwo by fishermen. The results obtained are summarized as follows:

(1) In 1953, *Skeletonema costatum* multiplied tremendously during June and August and therefore this indicates that the red tide in summer is nothing but the summer flowering of *Skeletonema*. Accordingly, it will be a matter of course that the red tide in summer occurs regularly every year and far from being harmful to fishes and shells, it rather provides a better condition for these organisms.

(2) The red tide in summer disappeared during mid August in 1953. From the results of the observation on seasonal changes of the size of *Skeletonema* and the chemical and physical conditions of the sea water, it may be said that the disappearance of the red tide was not caused by environmental factors, but by the reduction to its minimum diatom size after which further growth being not possible death took place.

(3) In 1953, Aoshiwo occurred on July 21st after a heavy rain and continued for several days in this region. This tide was caused by the abrupt multiplication of *Pontosphaera sp.* At the same time the decrease of *Skeletonema* was noticeable. During that time fishes, especially which lived in the bottom layer, died considerably.

They also made avoiding movements toward offshore waters. However it may be suggested that the injury to marine organisms was not caused by the abrupt blooming of *Pontosphaera*, but originated as a result of another cause, that is, the remarkable but sudden formation of an oxygen-lacking-layer in the sea water near the bottom which was possibly caused by the decomposition of *Skeletonema* killed by the inflow of a large quantity of fresh water.

70. A study on the pisci-culture in brackish waters. Nakaroku NAKAMURA (Collection of Works on Fish. Sci. Jubilee Publication of Prof. I. AMEMIYA, Univ. of Tokyo Press, 11–49, 1957)

Salinity content of water is one of the most important factors which is directly concerned with the lives of fresh water fishes and the productivity of the pond in the pisci-culture at a sea-side district. During 1945-1949, some experiments and surveys were carried out to clearly understand the influence of salinity on the living condition and the yield of some important fishes-the carp, crusian and mullet, and also on the thriving of phytoplankton, the amount of minute food organims, etc. in the pisci-culture ponds in the Tokai region. Results so far obtained are as follows:

(1) High limit of salinity for the incubation of the carp eggs and the living of the small carp is respectively as much as $4.5^{0}/_{000}$ and $6^{0}/_{000}$ in chlorinity or thereabouts. Salinity affects not only the rate of hatching, but also the body length of the hatched fries. Both the carp and crusian have considerable ability for acclimatization to brackish waters and on the natural conditions they are sometimes found in the pond of which water is considerably briny.

(2) Feeding activity of the carp is variously influenced according to the grades of salinity, but its effects also reduce by acclimatization. The growth of the carp in the water of various grades of salinity does not show a recognizable difference when the fishes are evenly feeded.

(3) While larvae of the mullet die in a few hours when they are put into fresh water suddenly, they are safe in brackish water of Cl 2‰ or thereabout, and also they can live in the fresh water by gradual acclimatization.

(4) Most fish ponds situated near the sea contain a few grams of Cl, and some of them have no small quantity of it, which is even dangerous to the life of the carp. Salinity of the pond-water is mainly derived from the sea water which invade into the pond through the floodgate from adjacent sea or river at times of high-tide, but the water welling out from bottom of a pond seems to have no large effect in the warmer season.

Consequently the grades of salinity in many ponds show large variation according to the situation, namely to the distance from sea or river, and on the other hand to the grades of management.

In the case of non-management, the water becomes more saltish from late spring to summer and it comes up to the maximum value of salinity in August in some ponds which are directly adjacent to the sea. On the other hand, the pond under good management is able to be maintained in the low concentration of salinity all the year round.

(5) The water colors of the ponds are multifarious, from greenish to brownish coloration. There is obvious interrelation in that the lower the salinity is, the more

the greenish colorations appear, and on the contrary the higher it is, the more the brownish ones do. While the water colors fully develop and the greenish colorations dominate in the warmer season, these do not develop as a whole and the brownish ones rather dominate in winter.

(6) The lower the salinity is, the more the phytoplankton thrives in the ponds. The most thriving of phytoplankton occurs in September or October.

Sessile and bottom fauna and macroplankters were investigated quantitatively. The lower the salinity is, and the more the thriving of phytoplankton is, the larger is the amount of these fauna, but the interrelation between them are not so distinct.

(7) Even in the cases where the salinity content is under the safety-limit for the carp, it is found that the lower the salinity is, the higher is the productivity of the fish in the pond.

No obvious relation is recognized between the yield of the mullet and the salinity content. And also there is no relation between the yield of the carp and crusian and the same of the mullet in the pond. Consequently it is necessary to take into consideration that the salinity of pond-water should be maintained under the safety-limit for the above three species, namely Cl 5‰ or thereabout.

(8) Above relation seems to be intimately connected with the phenomenon that the lower the salinity is, the more the so-called "Aoko" (some types of phytoplankters belonging to Cyanophyceae) thrive in the ponds. The fact shows that "Aoko" has a significant meaning for the pisci-culture in the stagnant water, especially in the ponds near the sea.

(9) Finally it seems to be most wise that one, for the elevation of the productivity of the fish pond by the mingleculture of the carp, crusian and mullet, strives to maintain the salinity content as low as possible and project towards more thriving of phytoplankton.

71. A study on the phenomenon of the Tobi-Koi or shoot carp. III. On the result of culturing the modal group and the growth of carp fry reared individually. Nakaroku NAKAMURA and Shogoro KASAHARA (Bull. Jap. Soc. Sci. Fish. 22, 674-678, 1957)

Dealing with early stages of carp fry, we showed in previous reports that shoot carp are already reconizable amoung the 20 day-old fry of the same batch and that their occurrence is fostered by certain feeding conditions.

In this paper, we examined the occurrence of the shoot carp at the later stages, by culturing the modal groups of the 70 day-old fry from one batch and of one-year-old seed carp. In a modal group, which is obtained by excluding shoot individuals from among the fish that were reared under the same condition, the original body length distribution is almost symmetric with a small standard deviation. When these modal groups are cultured for 3 to 12 months, their body length distribution becomes considerably skewed, evidencing that shoot carp have occurred anew. And, shoot carp occur to a greater degree when the 70 day-old fry are cultured than in the case of the one-year-old carp.

Furthermore, individual carp fry of a batch are accommodation in separate vessels and reared with sufficient diet, for the purpose of examining their growth as absolutely unaffected by the mutual competion for diet. Under this rearing condition, growth of the fry is quite uniform; in other words, no shoot carp occur at all.

These results endorse our view that food competition among individual fish is a causative factor of the phenomenon of the shoot carp.

72. Notes on the young of the black porgy, *Mylio latsu* (HOUTTUYN). Shôgorô KASAHARA (Jap. Journ. Ichthology, **6**, 20–25, 1957)

The "kichinu" or "kibire", *Mylio latus* (HOUTTUYN), and the "kurodai", *Mylio macrocephalus* (BASILEWSKY), are regarded as the same fish for commercial purposes, because these two varieties of the black porgy look very alike, show similar geographical distributions and are equally prized as food fish. They differ, however, in various biological characteristics, of which the spawning season is most noteworthy. While *Mylio macrocephalus* spawns in spring, *Mylio latus* spawns in autumn. This suggests the possibility that a new type of fish culture may be developed for brackish waters, in which the young of *Mylio latus* are stocked in brackish fish ponds in autumn and raised to marketable size by the end of next autumn.

The author carried out some morphological and ecological studies on the young of *Mylio latus* collected in Fukue Bay, Aichi Pref., in order to get informations necessary for such type of fish culture. The results obtained are as follows:

(1) In the young, of body length 10.7-25.3 mm, the ratio of body length to body height become smaller with the growth of the fish, i.e., the body form gradually approaches to that of the adult fish. At the same time, the horizontal patterns on the body side increase in number from one to six.

(2) Young "kichinu" were reared in the water of low chlorinities, and their survival rate was recorded. The lower limit of the chlorinity, harmless to these fish, was about 4‰ Cl.

(3) When fed with mysid shrimp, young "kichinu" daily took about 21% as much shrimp as their own body weight at the water temperature of 20°C. The lower the temperature became, the less food they took. At temperature below 5°C they did not take food. They lay down on their side when exposed to the low temperature of about 2°C for 30 minutes.

73. On the measurement and notation of the water color of pisci-culture ponds by the MUNSELL-color system. Nakaroku NAKAMURA (Jap. Journ. Limnol, **18**, 125–133, 1956)

We had hitherto no suitable method to measure or notate the color grades of inland waters, especially of the extremely eutrophic ones like the pisci-culture ponds. Now, the MUNSELL Book of Color provides an orderly arrangement of standard papers which serve as guide for the measurement and notation of all colors, and, in addition, it has the characteristics in that these standards represent equally spaced divisions of the three attributes of color, known in the MUNSELL System of Color Notation as Hue, Value and Chroma.

By using the MUNSELL Book of Color, we can easily and quickly specify and notate the color of a substance by simple numerals, instead of obscure, non-related, customary name of color, and can also let it be known internationally. Strictly speaking, the MUNSELL Color System is a method for the notation of the surface color of substances, but is impossible to use for either the color of a liquid or the source of light. This method can, however, be employed in the case under consideration, because the water-color of pisci-culture ponds is the characteristic Vegetationsfarbung", which

is caused chiefly by the thriving of phytoplankton, etc., and can be considered as a sort of surface color.

In 1955, the author has measured and recorded the water color of eel-culture-ponds in the Tokai region by using the MUNSELL Book of Color. By these records, the author has investigated the seasonal variation of water-color, the comparison of water-colors of fish-ponds in different districts, the relationship between the water-color and the salinity of pond-water, and also the relationship between the composition of phytoplankton and the water-color respectively. The results obtained are as follows:

(1) Seasonal variation of the water-colors of the ponds in the Izumi district was cleared. The maximum value of Hue, 35.0 (5.0 BG), was recorded in August.

(2) The Hue value was usually very high in the ponds in both the Kawajiri and Hamana districts (both in Shizuoka Pref.), considerably high in ponds of various districts of Aich Pref., and the lowest in the ponds in Mie Pref.

(3) There was a clear tendency in that the higher the salinity of pond-water, the lower is the Hue value of the water-color.

(4) While the blue-green algae, such as *Microcystis*, *Oscillatoria*, etc., are the source of the higher value, as 37.5-40.0 (distinct bluish green coloration), the green algae (*Scenedesmus* and others) show the tendency to manifest a little lower Hue value, as 30.0-35.0 (green or yellowish coloration). There is also a tendency that the predominance of green algae and in particular the planktonic diatoms reduces not only the Hue value but aslo the Value and Chroma.

74. Studies on the breeding of the 'Nori', *Porphyra tenera* KJELLM, I. The races or varieties found in Ise-Mikawa Bay. Seibin ARASAKI (Collection of Works on Fish. Sci. Jubilee Publ. Prof. I. AMEMIYA, Univ. of Tokyo Press, 805-818, 1957)

Most of the algologists think that almost all materials of cultured *Porphyra* fall within one species, *Porphyra tenera* KJELLM. and consisting, at most of two forms, *f. typica* and *f. kjellmani*, or referred to as two types the *long type* and the *round type*. However, the 'Nori'-fishermen distinguish many kinds, of different commercial value wihtin the 'Nori', from the view points of growing district, harvesting time, shape or color of the fronds, and so on. Concerning to such contradictory views, KUNIEDA (1938) mentioned that many species are involved within the so called *P. tenera*, and they can be classified into two major groups: i.e. the long type and the round type, by means of their mode of reproduction and development.

Investigating the 'Nori' materials found in esveral cultivation grounds in Ise-Makawa Bay for about twelve years, the present author came to conclusions different from the opinions of other previous workers.

As for the mode of development, that is to say, how many cells in a single row does the uni-seriated germling acquire until the time when the first longitudinal division takes place, there are at least four groups: a) less than ten, or 3-9 cells (usually 5-7); b) 10-16 cells (usually 13-15); c) 17-23 cells, and d) more than 24 cells. As for the method of reproduction, it was observed that all members of the 'Nori' produce monospores which develop to fronds having, in some cases, monospores again, or in some cases, carpogonia and antheridia. According to the size of the fronds which are capable of producing monospores, they are classified into the following four groups: i.e. a) only once at minute germling stage of less than 1 mm.; b) at about

1 mm. stage, c) until about 10 mm. stage, and d) until the larger size of 30-60 mm. Combining together both characteristics, the 'Nori' may be classified into the following five major types.

Type	Cell number at first 1.-div.	Frond size having monosp.	Shape of frond
I	3—9	50—60 mm	Round
II	10—16	10 mm	Oblong or long
III	10—16	1 mm	Oblong or round
IV	17—23	Less than 1 mm	Long
V	More than 24	Less than 1 mm	Slender

The shape of fronds in each type is much variable, and among the members of each type there are a few groups which are distinguishable from each other by more minute characteristics such as the aspect of cystocarp-sori or color of frond. By such classification, i.e. into five major groups, we can explain reasonably the various biological phenomena in the culture ground, especially differences in the harvest time, or seasonal changes in the quantity of the crop, or between materials originated from different nursery places.

The author presumes that all members of these five types belong to *P. tenera*, and each type or group may correspond to race, forma, or at most varieties. While it still needs further discussions and criticisms to solve such taxonomic problems, the author thought it more convenient to treat these types or groups as the economic races.

75. Studies on the protoplasm of algae. Part 2. On the "perforating disease" of laver. K. NOZAWA, and Y. NOZAWA (Bull. Jap. Soc. Sci. Fish. 22, 694–700, 1957)

In the previous paper, the authors reported the remarkable resemblance ebtween "perforating disease" and deformation of laver cells caused by mechanical, chemical or osmotic action of environments.

When a part of *Porphyra*-frond is injured mechanically by the tip of a needle and then put into diluted sea water or fresh water, protoplasm of the operated cells coagulate very easily and the stimulation effect spreads gradually into the non-touched surrounding cells resulting in deformation. The aspect of the deformed cell and the width of the deformed area vary with the concentration of the media in which the operated piece is immerced; i.e. it does not occur in hypertonic water of more than about 12‰ Cl, between 10-12‰ Cl the deformation is inconsiderable, and in less than 10‰ Cl it continues for some periods with an intense grade, and especially under 6–8‰ Cl the deformed area decomposes into a hole. In the culture ground the disease often occures after vigorous rain, especially along places near estuaries.

From these, it is concluded that the so called "perforating disease" is a non parasitic disease. It seems to be brought about by a physiological disturbance of the plasmoptyse of cells accompanied by a decreased permeability in plasma membrane and viscosity of plasma, owing to the injure and the hypotonic media.

The disease "Shirogusare" reported by ARASAKI (1947) also seems to have some affinity with the present disease, in the pathogenetic sence.

76. An ecological study of *Undaria pinnatifida* SUR. Part 1. On the influence of environmental factors upon the development of gametophytes. Yûnosuke SAITO (Bull. Jap. Soc. Sci. Fish. **22**, 229–234, 1956)

It has been reported by many authors that the shape, size and growth rate of gametophytes of Laminaliaceae vary according to culture conditions, such as temperature, light intensity and amount of nutrient salts etc.

In order to make the problem more correct and detailed the present investigation was carried out concerning the influence of environmental factors upon the development of *Undaria pinnatifida* collected in Ise Bay.

Results obtained may be summarized as follows:

(1) Zoospores germinate within 13-24°C, gametophytes grow well at 15-23°C, but the development delays or stops at temperatures higher than 25°C. At much higher temperatures, however, some individuals die. After the dormancy during certain periods of higher temperatures, the gametophyte begin budding afresh in September when the temperature becomes lower.

(2) Germination of zoospores occur in comparatively wide ranges of chlorinity (7-21‰), though the germination ratio decreases at lower chlorinity levels. Better development is seen above 15‰ of chlorinity, but the development is retarded at chlorinities below 13‰. The survival rate at lower chlorinity gets worse with the rising of temperature.

(3) Moderate illumination seems to be necessary for the growth of gametophytes, and it does not occur in darkness. But the optimum grade of illumination seems to vary with the change of season, namely, of the temperature.

(4) Under variously coloured illuminations the development of gametophytes proceeds normally and they grow well in blue, light green or pink lights but the growth seems to be delayed in orange light.

Part 2. On the influence of environmental factors upon the maturity of gametophytes and early development of sporephytes. Yunosuke SAITO (Bull. Soc. Sci. Fish. **22**, 235–239, 1956)

The present investigation was carried out to clarify the effects of temperature, chlorinity of sea water and light upon the maturity of gametophytes and the early development of the spoorphytes of *Undaria pinnatifida*.

Results obtained may be summarized as follows:

(1) The formation of sexual organs in gametophytes, both of male and female, occurs usually below 20°C, and it does not occur at higher than 23°C.

Sporophytes can develop below 20°C. They grow normally within 10-17°C.

(2) The maturation of gametophytes and the growth of sporophytes are affected by chlorinity less than 15‰ Cl.

(3) The maturation of gametophytes and the growth of sporophytes seem to be greatly affected by the colour of light and the illumination. A rather higher intensity seems to be necessary for the formation of female sexual organs and for the development of sporophytes, as the processes are delayed or do not occur in dark or in reduced light. But the antheridia can be formed even in dark.

(4) Among variously coloured light, orange light was found unfit for the development of gametophytes and sporophytes.

77. Massive destruction of fish due to low temperature of the sea water in the Pacific coast of central Japan. Ikusaku AMEMIYA, Takashi HIBIYA and Haruyuki KOYAMA (Collection of Works on Fish. Sci. Jubilee Publication of Prof. I. AMEMIYA, Univ. of Tokyo Press, 657-673, 1957)

By the end of March, 1947, a vast number of fish were seen drifting almost paralized in the Pacific coast of central Japan, and the event lasted till the beginning of May. Since December of the preceeding year, a marked springing up of cold undercurrent was found off Bôsô Peninsula and adjacent to Mikomoto Island in Izu. Surface water temperature at the coastal stations fell down suddenly some days prior to the occurrence of this drift. The drift of numbed fish extended from the outer coast of Bôsô Peninsula to the southern sea area of Izu Peninsula. It was found that nearly all of the subtropical or temperate reef-fish species of these localities, which is almost the northern limit of their zoo-geographical distribution, were in drift. Some of them were scooped up by fishermen and the others were found dead or stranded.

The fish catch with the various coastal fishing gears declined during the continuation of the drift.

78. Studies on the adrenal glands of teleosts-1. Some observations from the viewpoints of comparative histology. Mikio OGURI and Takashi HIBIYA (Bull. Jap. Soc. Sci. Fish., **23**, 625-621, 1957)

Histological observations were made on the acidophil cells and chromaffin cells in the lymphoid head kidneys and on the Stannius bodies of three species of fishes (*Carassius auratus*, *Parasilurus asotus* and *Hexagrammos otakii*).

The acidophil cells surround the cardinal veins and their branches in the head kidneys and are arranged making lobules (in *C. auratus*), cords (in *H. otakii*), or stratifications (in *P. asotus*). Their cytoplasms are acidophil but free from lipoid droplets. They are believed by some authors (BAECKER and GIACOMINI) to be homologous to the adrenal cortex of mammals.

The chromaffin cells corresponding to the adrenal medulla are situated either near the acidophil cells (in *H. otakii*), particulary in the walls of the cardinal veins (in *P. asotus*) or scattered as single cells or groups of cells in the acidophil cell masses (in *C. auratus*).

On the other hand, the Stannius bodies described by some writers (DIAMARE and VINCENT) as homologous to the adrenal cortex are present in all species of fishes investigated. They are a pair of small, white and semi-spherical bodies which lie on the dorsal (in *H. otakii*) or ventral (in *P. asotus*) surface of the posterior region of the kidneys or near the proximal part of the ureters (in *C. auratus*). The Stannius bodies resemble the interrenal bodies of elasmobranchs in histological structure but no lipoid droplets are detected.

Histologically, some remarkable differences are observed between the cortical cells of mammals and either the acidophil cell groups or the Stannius bodies. Therefore, further investigations are necessary to decide finally the organ homologous to the adrenal cortex of mammals in teleosts.

79. On the absorption of nitrogen compounds in different forms in sea water by a marine plankton diatom, *Skeletonema costatum* (Grev.) Cleve. Yoshiyuki MATSUE (Collection of Works on Fish. Sci., Jubilee Publication of Prof. I. AMEMIYA, Univ. of Tokyo Press, 249–257, 1957)

Three kinds of inorganic nitrogen compounds, nitrate, nitrite and ammonium, are found in sea water. Although they are all considered to be absorbed by general phytoplankton species, each nutritional properties for plant cells are known to show considerable differences in various points.

The author made culture experiments on a marine plankton diatom, *Skeletonema costatum*, to determine the inhibitory concentrations of these three forms of nitrogen, and to see the preference in absorption among these salts by the diatom.

In the media in which *Skeletonema costatum* are growing, there usually can be found a reaction that nitrate gets reduced to nitrite, to some extent. Though, this reaction was regarded by some former investigators as to be the extracellular, reduction of the living plant cells, there still remains much to be investigated to come to a definite conclusion. As a consequence, observations and experiments were carried out by the author upon this phenomenon with the intention of getting more reliable data about its mechanism.

The results obtained are as follows:

(1) The inhibitory concentrations of nitrate, nitrite and ammonium for Sk*eletonema costatum* were determined to be as 64, 32-64 and 0, 4 milli-mol respectively. The result tell us that these values are much different from those obtained on other diatom species such as *Nitzschia closterium* by a former investigator.

(2) When ammonium was added with either nitrate or nitrite to the medium in same concentration (0,1 milli-mol), a very marked preferential absorption of ammonium by *Skeletonema costatum* was observed; either nitrate or nitrite cannot be absorbed by the diatom while there remains any trace of ammonium in the medium.

(3) In the medium added with both nitrate and nitrite in same concentration (0,1 milli-mol), a slightly preferential absorption was observed on the former. At this experiment it was confirmed that the error which might be introduced by the reduction of nitrate to nitrite in the culture medium, was negligible.

(4) As to the nitrate reduction in the culture medium a conclusion was given tentatively that it should not necessarily be the normal extracellular reduction of the diatom, but it might as well be the nitrate-reducing action of some bacteria mingling with diatom in the culture. Results of the observations and experiments carried out concerning the phenomenon are reported in this paper.

80. On the distribution of minute nutrients in the North Japan Sea, during the close of August, 1955. Yoshiyuki MATSUE, Yuzo KOMAKI and Masaaki MURANO (Bull. Japan Sea Reg. Fish. Res. Lab. **6**, 121–127, 1957)

During the close of August, 1955, oceanographical investigations by Soyo-Maru were carried out in the northern part of Japan Sea. We were alloted of a part of the determinatoins of minute nutrients (silicate-Si, phosphate-P, nitrite-N and nitrate-N), hydrogen-ion concentration and alkalinity, in this co-operative survey with the Japan Sea Regional Fisheries Research Laboratory. At seven stations, the water samples were collected from thirteen layers down to 1,000 m., but at a

few stations the samplings were confined to shallower depths for reasons of shallow depth of sea or stormy weather.

At stations where the warm Tsushima Current may pass through, the contents of nutrients (Si, P and nitrate-N) suddenly increase between depths of 100 to 150 m., but at other stations the uncontinuous layer can be found in shallower depths of 25 to 50 m. Generally, the depth of the uncontinuous layer of nutrients is markedly shallower than that of the Pacific. This fact can also be observed in the vertical distribution of the hydrogen-ion concentration, pH_{20} (converted value at 20°C) which drops below 8.0 at the depth of 100 m.

From the distributions of these nutrients or pH each branch of the warm Tsushima Current can be traced fairy well. In the area around the Yamato Bank a considerable up-welling can be detected, and it can be supposed that a part of the Tsushima Current water descends in the northern area of the Bank to make up for the loss of water caused by the up-welling, above mentioned.

A note on the influence of water temperature upon the value of pH in colorimetric determination is also added. And it is emphasized that as the colour of the indicator is turned by the variation of temperature, to obtain the precise value of pH and to calculate the correct value of total carbon dioxide content in sea water from pH and alkalinity a correction is indispensable. For this correction the following BUCH's equation can be adopted:

$$pH_{tw}=pH_{tb}+\alpha(t_b-t_w)+\beta(t_w-t_w).$$

81. On the distributions of minute nutrients in the North Japan Sea; March-April, 1956. Yoshiyuki MATSUE, Yuzo KOMAKI and Masaaki MURANO (Bull. Japan Sea Reg. Fish. Res. Lab. **6**, 316–320, 1957)

The second oceanographical investigations, in the northern part of the Japan Sea were carried out in co-operation with the Japan Sea Regional Fisheries Research Laboratory, on board the Tenyo-maru in March and April, 1956. We were in charge for the determinations of nutrients, (silicate-Si and phosphate-P), pH and alkalinity, similar to the first investigations of last summer. The water samples were collected from nine layers down to the depth of 300 m. at eighteen stations and at two of these stations, between which the Yamato Bank was located, samples were collected from three more layers down to 800 m. of depth.

Except the area where the branches of the warm Tsushima Current flow, the stratification of the sea water is not obvious as compared with that of last summer. This fact can be explained from the vertical distributions of nutrients and pH as well as from that of water temperature. In the branches of the Tsushima Current, the nutrients increase suddenly between depths of 100 to 150 m., similar to last summer and each branch of the Tsushima Current can be traced fairly well.

The third branch of the Tsushima Current (the East Korea Current) flows over the Yamato Bank. It flowed nearer to the coast of Honshu than last summer. It may be caused by the drifting of the northern cold water pushed towards Honshu by the winter north-western monsoon.

In the surface layer, particularly in the northern area, the contents of nutrients of the sea water are more abundant to some extent than that of last summer; but in the 'proper' water of the Japan Sea, extending below the depth of 100 or 150 m., these are not so much different from the observations made last summer.

82. **Methods for the determination of dissolved oxygen in waters.** Aritsune SAEKI (Aquiculture, 5[1], 27–33, 1956)

Methods for the determination of dissolved oxygen are discussed and the modified Winkler-Sugahara gasmetric method is devised. Methods to determine dissolved oxygen are as follows:

(A) Winkler method and its modification.

(a) When water is free from seston.

Winkler method, "Short Theriault" modification, Alsterberg mod., Rideal-Stewart mod., Pomeroy-Kirschman mod., Alkalinehypochlorite mod., Sample-blank method.

(b) When water contains seston.

Alum flocculation modification, Copper sulfate-sulfamic acid flocculation modification.

(B) Other methods.

Miller's method, Amidol method, Gasmetric method, Galvanometric and polarographic methods.

83. **Concering methods for estimating nitrogen compounds in the water of an inland sea.** Aritsune SAEKI (Aquiculture 4[2], 12–21, 1956)

Methods for estimating nitrate, nitrite, ammonia and organic nitrogen are discussed, and some new devices are made to determine ammonia, the so-called alubuminoid nitrogen and "hypobromide" nitrogen. By these methods the nitrogen compounds of waters of Shinagawa Bay, off-sea of Kawasaki district and Ueno sea-water closed-circulating aquarium were determined.

84. **Some notes on the methods for estimating oxygen consumed from permanganate.** Aritsune SAEKI (Aquiculture 4[1], 27–33, 1956)

Methods for estimating oxygen consumed from permanganate are discussed. And C.O.D. of the waters and some organic substances are determined by modified Schulze method. The followings are the conclusion from the experimental results.

(1) When the water contains much nitrite, 1-2 drops of sodium azide should be dropped soon after adding potassium iodide solution.

(2) C.O.D. of 1 mg. glucose, starch, glycerol, sodium glutaminate and poly-pepton are 2.00, 0.98, 2.50, 7.78, 8.33 and 4.76 mg. respectively.

(3) Ratio of reduced potassium permanganate to added one should be within 20%.

85. **The noxious condition of the water in a newly constructed concrete aquarium.** Aritsune SAEKI (Jap. Journ. Lim. 18, 118–124, 1956)

The water in the newly constructed concrete aquarium or pond is noxious to fish. It is said that this is caused by the lime which is given off from the fresh concrete. The author has made experiments on this condition by immersing the fresh mortal blocks in the well-water, distilled-water, sea-water and pond-water respectively. It was observed that the fresh mortal block absorbed carbon-dioxide from the water and gave off some caustic alkalis. This process made the water more alkaline, lower alkalinity and less content of calcium.

The gold-fish cultured in the water of such an aquarium died within an hour,

but was normal and healthy when the water was neutralized with dilute hydrochloric acid. So it is suggested that such a noxious condition of the water is caused by the absorption of carbon-dioxide and the resolution of free alkalis.

For this reason the seasoning of the concrete is necessary for about a month before the beginning of fish culture, and it may be hastened by either the addition of alum or painting with sodium silicate solution. It may also be useful to paint bilon (biniel) which needs no seasoning.

86. A simple determination of vitamin A in margarine. Part 1. A simple method to remove the artificial dyes, yellow AB and OB. Koji NAITO and Takajiro MORI (Jour. Vitaminology 2, 283–286, 1956)

In the assay procedure of vitamin A added to margarine, coloring materials have to be removed from unsaponifiable fraction prior to colorimetric or spectrophotometric determination of the vitamin, as they interfere with the estimation. The authors have devised a simple extraction method to remove the artificial dyes, yellow AB and OB, from the unsaponifiable fraction of margarine by treating the petroleum ether solution with glacial acetic acid containing a small amount of acetaldehyde.

This method is applicable for the determination of vitamin A in the margarine containing no carotenoid and gives the recovery of the vitamin of over 96%.

Part 2. On the reaction between yellow AB or OB and aldehydes. Koji NAITO and Takajiro MORI (Joun. Vitaminology **2**, 287–295, 1956; Vitamins, **11**, 521–527, 1956)

In the extraction method reported in the previous paper, Yellow AB and OB easily transfer themselves to acetic acid layer from petroleum ether, changing their colors to reddish purple.

The reaction involved here was studied, and it was found that Yellow AB (phenylazo-β-naphylamine) and yellow OB (*O*-tolylazo-β-naphylamine) condense with acetaldehyde to form phenylazo-acetaldehyde-β-naphthylimide and *O*-tolylazo-acetaldehyde-β-naphthylimide, which is readily soluble in acetic acid. The above mentioned reaction products were confirmed by elementary analysis and infrared spectrum.

The condensation products of both pigments with several aliphatic and aromatic aldehydes were also synthesized for reference and their chemical properties, such as melting point, absorption peak and solubility were described.

Part 3. A reduction method of the artificial dyes, yellow AB and OB, by sodium hydrosulfite. Koji NAITO and Takajiro MORI (Vitamins **11**, 528–531, 1956)

Another simple method has been devised to exclude the disturbance of Yellow AB and OB in the determination of vitamin A added to the margarine. The reduction and decolorization of the dyes were attained without the appreciable loss of vitamin A by treating the unsaponifiable fraction in petroleum ether with sodium hydrosulfite in glacial acetic acid. The vitamin A in the margarine containing no carotenoid was satisfactorily determined by this method with the recovery of over 93%.

It was also confirmed that Yellow AB, phenylazo-β-naphthylamine, decomposes into 1,2-naphthylenediamine and aniline in the reduction with sodium hydrosulfite.

87. B-vitamins in marine products and their changes during processing and storage. Part 2. Canned baby clam. Yasushi KOMATA, Yoshiro HASHIMOTO and Takajiro MORI (Bull. Jap. Soc. Sci. Fish. **23**, 44–46, 1956)

The effect of canning procedure and storage on B-vitamins in shucked meat of baby clam was studied. The shucked meat was cooked in boiling water for 15 minutes and then packed in No. 7 cans (6.8 cm.×10 cm.) with 3% brine acidulated with glacial acetic acid as in the usual manner. The packed cans were sterilized by heating at 115°C for 60 minutes and stored at room temperature for 6 months.

The loss of vitamins during the heat sterilization and succesive storage was found to be very small and even thiamine was relatively stable, perhaps due to the acidic medium of can contents (pH 5.2).

The large amount of B-vitamins, however, was lost in the precooking procedure, and the retention through the whole procedure was only 17% for thiamine, 35% for riboflavin, 22% for niacin 34% for folic acid, and 44% for vitamin B_{12}.

Furthermore, about 30∼40% of the retained vitamins in a can was found to be present in the juice, which will not always be taken by the consumer.

88. Free amino acid composition of "Katsuwo-no-shiokara". Takajiro MORI, Yosoiro HASHIMOTO, Yasushi KOMATA and Sadanari EGUCHI (Bull. Jap. Soc. Sci. Fish. **23**. 37–50, 1957)

Free amino acids of "Katsuwo-no-shiokara" were analyzed by a microbiological method on three kinds of extracts prepared with hot water, trichloracetic acid and tungustic acid solutions respectively.

Among the three extractants used, tungustic acid was found to be most suitable for obtaining the extracts, less in proteins or peptides. Free amino acids determined, however, showed no significant difference according to the extraction method and fairly coincided in their values with those of the proteins in animal entrails including fish viscera. This may suggest that the free amino acids accumulated in "Katsuwo-no-shiokara" represented the pattern of amino acids in proteins of the starting material, skipjack viscera.

89. Studies on the crystalline style of molluscs. V. Chemical constituentsof the style of Mactra sulcataria Reeve (Part 3.) Yoshiro HASHIMOTO and Tokuji SATO (Bull. Jap. Soc. Sci. Fish. **22**, 417–419, 1956)

D-Glucosamine and chondrosamine were isolated from the style mucin and identified. They were preliminarily detected by the minhydrin degradation method of FUELIUS and GIRARD, using the basic fraction isolated by an ion-exchange resin, Amberlite IR 120 from the style hydrolyzates. The degradation products with ninhydrin gave two spots of pentose on the paper chromatogram, indicating the presence of glucosamine and chondrosamine; one spot well coincided with the Rf value, with arabinose resulting from the authentic glucosamine, and the other with that of a pentose from chondrosamine.

Then, both hexosamines were respectively isolated as hydrochloride in the crystalline state and they were also derived to 2-hydroxynaphthylidene hexosamines for identification. The analytical data on nitrogen, melting point and specific rotation clearly indicated that the hexosamines were D-glucosamine and chondrosamine.

90. Chemical studies on the red muscle, "Chiai", of fishes. Part 6. Solubilities of red muscle myoglobins and blood hemoglobins. Fumio MATSUURA and Kanehisa HASHIMOTO (Bull. Jap. Soc. Sci. Fish., **22**, 408–12, 1956)

The solubilities of myoglobins (Mb's) of tuna, *Parathunnus sibi,* and swordfish, *Makaira mitsukurii,* were determined in the phosphate buffer solutions of high ionic strength and compared with those of Mb's and hemolobins (Hb's) of other fishes.

In the first experiment, solubility determination was carried out on carbonyl derivatives of these pigments in a phosphate buffer solution of pH 6.6 at 20°C. In solubility, fish Mb's lay between fish or mammalian Hb's and mammalian Mb's. The tuna Mb derivatives, such as carbonyl-, reduced-, cyanmet-, and met-Mb showed a similar solubility, whereas the met-form was slightly more soluble than the others.

The second experiment, intended to study the influence of pH and temperature on the solubility of tuna met-Mb, resulted in some interesting findings; the Mb had no minimal solubility within the pH range, 7.20~4.54, covered here, though its isoelectric point was found between pH 6 and 7. Further it was shown that this protein has a typical negative temperature coefficient within the temperature range, 0~44°C.

Thus fish Mb's revealed a remarkable specificity, also in the solubility as well as in the other properties previously reported.

91. Studies on the accumulation of fission products in the fish. Part 1. Takajiro MORI, Keishi AMANO, Toshiharu KAWABATA and Masamichi SAIKI (Papers of the First Conference on Radioisotopes, Japan Atomic Industrial Forum, 546–551, 1957)

The distribution of radioactivity and radioactive elements in fishes caught in the Pacific Ocean in 1954 have been investigated.

The highest radioactivity was found in viscera with less in bone, skin and muscle. The radioactive elements in fishes were analyzed by the radiochemical method, and Zn^{65} was found to be responsible for the high activity of the contaminated fishes. The nuclide was found to be very widely present in a fish body, i.e. in muscle, pyloric caeca, liver and other organs.

The uptake and accumulation of Nn^{65} by laboratory fishes were also examined. The distribution of radioactivity in experimentally contaminated fishes with Zn^{65} closely resembled to that observed on the fishes caught in the Pacific Ocean.

92. Radioactivity and its decay of the plankton, seaweed, sea-urchin, cuttle-fish and stomach contents of fish. Masamichi SAIKI, Susumu OHNO and Takajiro MORI (Reports of the Research on the Influences of the Nuclear Bomb Test Explosions, Ministry of Health and Welfare, 1–4, 1956)

Various specimens collected at the western region of the so-called "dangerous zone" around the Bikini and Eniwetok Atolls in June, 1956 by the "SHUNKOTSU-MARU" were examined for their radioactivity. On the whole, these specimens were less radioactive than those of 1954.

Comparatively high radioactivity was detected in small fishes, such as sacker, shrimp and cuttle-fish, which consisted the stomach contents of the tunny. The radioactivity of plankton was also high and its half life was 10 days in June 15~25, 40 days in August, 100 days in November. It was noticeable that no decay was

observed on the liver of a fish, *Lepidocybium flavobrunneum*, through the experimental period.

93. Studies on the radioactive materials in the radiologically contaminated fishes. Part 2. On skipjacks caught in the Pacific Ocean in 1956. (1). Masamichi SAIKI, Kazuo SHIRAI, Susumu OHNO and Takajiro MORI (Bull. Jap. Soc. Sci. Fish., **22**, 645–650, 1957)

The distribution of the radioactive elements in two specimens (No. 6 and 13) of skipjack, *Katsuwonus pelamis*, have been investigated, which were caught at a station (14°03′N, 157°28′E) in the Pacific Ocean on June 13, 1956 by the "SHUN-KOTSU-MARU". These specimens were less radioactive, but more interesting than those of 1954, as they represented more complicated patterns of contamination.

The radioactive substances in the pyloric caeca (13P) of No. 13 specimen were mostly composed of the members of Group II and Group IIIB, which contains Zn^{65}. Zn^{65} was again isolated and identified, as reported in the previous paper. In the pyloric caeca (6P) of No. 6 specimen, on the other hand, no appreciable amount of Zn^{65} was found and the radioactivity of 6P was mainly attributable to the radioactive elements of Group II.

It was found that members of Group II also took the major part of radioactivity in the liver (6 L and 13 L) of both specimens and those of Group IIIB in which Zn^{65} was included, revealed only slight activity. Group IV (alkali-earth metals) from 13 L was further fractionated, and Ba^{140} together with La^{140} were found to be responsible for the radioactivity of the group. The presence of Fe^{55} was also confirmed in 6 L.

Part 3. On skipjacks caught in the Pacific Ocean in 1956. (2). On the presence of Cd 113m. Kazuo SHIRAI, Masamichi SAIKI and Susumu OHNO (Bull. Jap. Soc. Sci. Fish., **22**, 651–653, 1957)

The members of "Group II", which were obtained in the group separating analysis of the ashes of the liver or the pyrolic caeca of the radiologically contaminated skipjacks, reported in the previous paper, had considerable activity and were further fractionated into individual members. The greater part of activity was found in Cd-fractions both from the liver and pyloric caeca. The refined Cd-fraction by reprecipitation showed no decay in 50 days and emitted no γ-ray. The maximum energy of the β-ray calculated from the aluminium absorption curve was found to be 0.6 MeV. The nuclide in this fraction was confirmed to be $Cd^{113}m$.

VI. Forestry

Abstract Nos. 94—104

94. Influence of electric shock on white grubs. Part 1. Mortal effect to the insect in the soil by high electric pressure. Kanji TACHIBANA (Bull. Tokyo Univ. Forests 52, 89–106, 1956)

Mortal effects of electric discharge on white grub, one of soil insects was studied. Two plates of brass, 3.8×2.1 cm in size, charged with direct current of 9,000 volts or with alternating current of 15,000 volts, were set in the sand filled in a wooden box and dischargings for various intervals of time were made between the plates set at different distances under controlled soil moisture conditions.

Discharging with D.C. 9.000 volts.

The most considerable effect of discharging was shown in the sand of 1.0 per cent water content and no effect was detected in moisten sand of water content higher than 10.0 per cent.

When the plates were set apart at more than 30 cm in distance, the effect became not obvious even in the sand of 1.0 per cent water content in which the effect of discharging was most effective.

Discharging with A.C. 15,000 volts (50~).

The degree of mortal effect reached to its maximum in the sand of 1.0 per cent water content. It decreased with the increase of water content and became nearly zero in soil moisture conditions higher than 5.0 per cent. Also the depression of the effect was observed with the increase of the distance between the plates.

The degree of the mortal effect raised with the increase of discharging time. A large number of insects were killed instantly and most of those that remained alive just after discharging died within 10 days after the treatment. Death caused by the discharging occured even after 30 days of the treatment.

95. A trial to paper chromatography. Ken-ichi HATANO (Journ. Jap. For. Soc. **38**, 425–427, 1956).

To remove the difficulty of separation of amino acids on the filter paper by partition chromatography, a device was tried on paper chromatography. Only two amino acids on the near position were extracted from a filter paper, and tested once more by paper chromatography. It appears appropriate by this result that, two ninhydrin sensitive substances, which the writer has pointed out as valine and an unknown, are decided to be γ-amino butyric acid and valine.

96. Measurement of fiber-length and specific gravity of Japanese giant poplar (*Populus japano-gigas*). Taizo INOKUMA, Ken SHIMAJI and Toshio HAMAYA (Misc. Infor. Tokyo Univ. Forests **11**, 77–86, 1956)

The fiber-length and the specific gravity in air-dry, of a 3-year-old plant of the Japanese giant poplar (*Populus japono-gigas*) were measured.

The general trend of the radial variation of the fiber-length coincided with those proposed by SANIO (1872) and AMOS et al. (1950). The variation from the ground level upwards was a constant decrease.

No regular variation of specific gravity was found.

The fiber-length and the specific gravity of a 10-year-old plant of the Japanese giant poplar were presumed from the data obtained on the 3-year-old plant, and compared with those of several other tree species which are now used for the pulp industry.

97. Native species of *Populus* in Japan. Toshio HAMAYA & Taizo INOKUMA (Forest Agency, Min. of Agr. & For., Tokyo, 1957)

Five species of the genus *Populus* have been described or reported in Japan. Of these, *Populus Sieboldi*, *P. tremula* var. *Davidiana* and *P. Maximowiczii* are comparatively distinct species, and in this paper their detailed descriptions are given, accompanied by the maps of their distribution in Japan and the figures of the representative individuals of them. Of the other two, *Populus jezoensis* is merely a form of *P. tremula* var. *Davidiana* with larger leaves of coarsely crenate dentation, and *Populus koreana* can be discriminated from *P. Maximowiczii* only by the viscid-glandular character of the young shoots and rugoseness of the upper surface of the leaves. It is noticeable that the leaves of *Populus* are polymorphous and that the same kind of leaves must be used in comparing the leaves of different species for their discrimination. The parts of branches below the summer buds (vernal branches) are of the character of short branches. The leaves on these vernal branches are much significant in the comparing of different species.

98. Notes on Japanese Ferns (9-12). Satoru KURATA (Hokuriku Journ. Bot, **5**, 77–80, 111–114, 1956; **6**, 7–10, 40–43, 1957).

Such ferns as *Athyrium arisanense* (new to Kyûshû-proper, Shikoku and Honshû), *Athyrium iseanum* form. *angustisectum* (grad. nov.), *Athyrium silvicola* (new to Japan), *Athyrium silvicola* form. *kinokuniense* (form. nov.), *Dryopteris commixta* (an independent species situated between *D. Scotti* and *D. atrata*), *Dryopteris kominatoensis* (perhaps, a hybrid fern between *D. monticola* and *D. tokyoensis*), *Dryopteris pycnopteroides* (new to Japan), *Grammitis Sakaguchiana* (the second locality in the Chichibu mountains, Prov. Musashi), *Polystichum neo-lobatum* (new to Japan). *Polystichum Ohmurae* (sp. nov.), *Polystichum tsus-simense* var. *Mayebarai* (stat. nov.), *Pteris Tokioi* (new to Japan) and *Pteris Tokioi* var. *yakusimensis* (stat. nov.) are taxonomically and plant-geographycally studied. *Polystichum Ohmurae* found *P. Fukuyamae* of Formosa. *Polystichum neo-lobatum* has been hitherto known in at two localities of the Southern Alps, is closely allied to *P. Wilsoni* of China and China and Formosa, and in Japan has only one natural habitat in a limestone region at the foot of the Southern Alps. It is noticeable that the same or closely allied species are distributed disjunctively in China, Formosa and the Southern Alps, Central Japan.

99. Wood decay of Abies sachalinensis forest in Tokyo University forest in Hokkaido (2). Toshio SASAKI and Shun-ichi YOKOTA. (Bull. Tokyo Univ. Forests **52,** 75–87, 1956)

The survey on wood decay of living *Abies sachalinensis* MAST. was carried out at three sample plots in the Tokyo University Forest, Hokkaido, in 1954. Results are summarized as follows:

Decay of living *Abies sachalinensis* in each sample plot

Sample plot 1 Sasazawa (53rd Division)

D. B. H. (cm)	Total Number of Trees	Total Infection	Proportion (%)	Total Volume of Trees(m^3)	Total Volume of Decay (m^3)	Proportion (%)	Dead Standing Trees
10～20	158	40	25.3	14.42	0.14	1.0	3
21～30	63	36	57.1	23.73	0.42	1.8	0
31～40	37	26	70.3	33.40	3.75	11.2	1
41～	25	21	84.0	59.99	4.60	7.7	1
Totals	283	123	43.5	131.54	8.91	6.7	5

Inclination 10’ ESE

Sample plot 2 Sannoyama (47th Division)

10～20	52	23	44.2	44.7	0.27	0.6	1
21～30	27	15	55.6	10.55	0.41	3.9	1
31～40	19	14	73.7	17.43	1.03	6.0	1
41～	3	2	66.7	5.72	0.54	9.4	1
Totals	101	54	53.5	38.17	2.25	5.8	4

Inclination 30° SSE

Sample plot 3 Sannoyama (50th Division)

10～20	39	26	66.7	3.48	0.25	7.2	1
21～30	21	19	90.5	8.98	0.96	10.7	0
31～40	12	10	83.3	11.66	0.46	3.9	2
41～	12	12	100.0	17.77	1.29	7.3	2
Totals	84	67	79.8	41.89	2.96	7.1	5

Inclination 25° NNW

Wood decay by Fomitopsis annosa (Fr.) Karst. was the greatest of all, amounting to more than 60% of the total volume of decay. Other principal wood destroying fungi were Phaeolus Schweinitzii (Fr.) Pat., Tyromyces balsameus (Peck) Murr., Phellinus Hartigii (Allesch. et Schnabl) Imazeki, etc.

100. Observations on the butt rot of Sakhalin fir (Abies sachalinensis Mast.) in the Tokyo University Forest, Hokkaido, with special reference to infection and propagation of decay. Shun-ichi Yokota (Bull. Tokyo Univ. Forests 52, 165–171, 1956)

The writer observed in detail by dissecting decayed butts and roots of Sakhalin fir and a scheme regarding the mode of propagation of butt rot was gained, that is,

upwards downwards
root ——→ butt ——→ other roots of the same tree
through openings at contacted part to inocula
——→ roots of the other tree ——→

101. On the standard wheelload-tension ratio of logging cableways. Seihei KATO, Eikichi KOIZUMI (Journ. Jap. For. Soc., **39**, 180–182, 1957)

The ratio of the amount of a wheel-load Q of a carriage to the tension T of the main cable is one of the important factors to obtain any adequate design of a logging cableway. The standard ratio is discussed theoretically, and $Q/T < 1/50 \sim 1/30$ is suggested, though it should be proved by empirical procedures later on.

102. Materials for the studies of growth in stands. Part 2. White pine (*Pinus strobus*) stands of various densities in Hokkaido. Masazi SENDA, and Taisitiroo SATOO (Bull, Tokyo Univ. Forests **52**, 15–31, 1956)

An analysis of growth was made on an about 40 years old plantation containing 4 plots of different densities ranging from 184 to 1742 stems per hectar. There was no appreciable difference in height among the plots. Both the length and the width of tree crown of the sample trees were larger in the plots of lower densities, but the ratio of the length to the width of crown did not show any difference among the plots. The ratio of the radius of the widest part of the crown to the average spacing did not differ among the plots and the ratio was about 0.7 in all plots. The form factor of the sample trees was smaller in the plots of lower densities, though the differences were not so wide. The amount of branches was larger in the plots of lower densities, both per tree and per unit area. The percentage of the branches in the total volume of wood material was also higher in the plots of lower densities. The logarithm of the weight of branches per tree had a liner relation with the logarithm of the number of trees per unit area. The amount of needles per tree was larger in the plots of lower densities, but the amount per unit area was nearly equal in all plots, and estimated as 19 metric tons per 1 ha in green weight. The logarithm of the green weight of the needles per tree had a linear relation with the logarithm of the number of trees per unit area. The amount of stem wood produced by unit weight of needle leaves was larger in the plots of higher densities, but over-density seemed not to be beneficial. The average of stem wood production per unit area in the last three years was larger in the plots of higher densities. The increment per tree in stem wood volume and in cross-sectional area were larger in the plots of lower densities and their logarithm showed liner relations with the logarithm of the number of trees per unit area. Before thinning, the frequency distribution of cross-sectional area deviated to the smaller parts. When thinning was made the deviation became little, but it grew gradually in the plots thinned weakly, though it was not yet recognized in the plots applied with heavy thinning at the time of the present study. These results substantiate the findings by the authors on young Japanese red pine stands of various densities, which had been reported previously.

Part 3. Amount of leaves and production of wood in an aspen (*Populus Davidiana*) second growth in Hokkaido. Toisitiroo SATOO, Rokuro KUNUGI, and Akio KUMEKAWA (Bull. Tokyo Univ. Forests **52**, 33–51, 1956.)

Studies were made on the growth of an aspen second growth, consisting of trees 25-40 years old, which was established after a forest fire and left for natural

development since its establishment. Aspens of small diameter died as the result of competition among trees, and mixed species consisted mostly of trees of smaller dimentions. 14 sample trees, including dominant, average, and suppressed trees, were taken from a quadrat 40×40 m, and measurements were made on the amount and current increment of the stem and the branches, the amount of leaves, and vertical distribution of branches and leaves. The amount of leaves and branches per tree showed close connection with the diameter of the stem at breast height. These values increased with increasing diameter of the stem more than their proportion to the diameter. The more leaves had a tree, the more wood was produced by it, but the amount of wood produced was not proportional to the amount of leaves. The amount of stem wood produced by unit amount of leaves decreased with increasing amount of leaves per tree, whereas the amount of branch wood produced by unit amount of leaves decreased with increasing amount of leaves per tree. Though the amount of stem wood production only was not of a linear proportion to the amount of leaves per tree, when the amount of production of branch wood and reproduction of leaves were added to it, in other word, when the dry matter production wastaken into account, the relations between growth and the amount of leaves came nearer to a straight line. From this fact, the authors suggest that the lower efficiency of leaves of dominant trees to produce stem wood is not caused by the mutual shading of leaves in them as claimed by many authors hitherto, but it is caused by the differences in the share of produced dry matter to various parts of the tree. The share of dry matter to the stem decreased and the share to the branches and to the leaves increased with increasing amount of leaves per tree. The amount of stem wood produced by unit amount of leaves of the average trees was: 2.84 cu. dm or 1.09 kg per 1 kg green leaves; 7.34 cu.dm or 2.81 kg per 1 kg dry leaves; or 0.66 cu. dm or 0.25 kg per 1 sq. m of leaves. One hectar of the stand studied had leaves of 5.5 metric tons in green weight, 2.2 metric tons in dry weight, 2.3 hectar in the area (single face), or 4.5-5.5 millions in number, and produced annually 8.7 metric tons of dry matter excluding herbs or 12.3 metric tons of dry matter including herbs.

103. Some statistical studies on the stand-composition of artificially-planted-forests (VII). Masao YOSHIDA and Taneo HIRATA (Bull. Tokyo Univ. Forests 52, 1–14, 1956)

1. On the stand composition of artificially planted forests of *Cryptomeria japonica* and *Chamaecyparis obtusa* at the Tokio University Forest (Chiba) we have had 6 reports and our 7th report is a review of our earlier reports and are summarized as follows:—

2. Mean height growth curves predicted at the first report on both species have come to be regarded as unsuitable to such a degree that they had better to be corrected.

3. Coefficient of variation of height and volume within a stand (C_h, C_v) is highly corelated with that of diameter, breast high (C_d). Values of C_h observed are about one or a half time as large as C_d and those of C_v observed about two or two and a half times as C_d.

4. The crown form i.e. the ratio of mean crown length to mean crown breadth is statistically regarded as independent on stand density and mean height of the stand. The difference between these valuse on both species is statistically insignificant

and the mean is estimated as 1.7.

5. From that stand volume per hectare (V) on basal area per hectare (G) multiplied by mean height (h) is statistically regarded as linear, stand form coefficients for V to Gh are practically estimated as 0.552 in case of *Cryptmeria* and 0.513 in case of *Chamaecyparis*, which values may be helpful for estimating stand volume by means of BITTERLICH's G- and BITTERLICH-HIRATA's h-estimating methods.

104. Wind damages in the Tokyo University forest in Hokkaido, Taneo HIRATA and Kanjiro MAEZAWA (Misc. Inform. Tokyo Univ. Forests, 11, 1–8, 1956)

From our observations on the storm damages of the Tokyo University Forest in Hokkaido, caused by the typhoon No. 15, on September 26-27., 1954, it can be concluded that: 1) Broad-leaved trees were wind-firmer than others, 2) Thinner stands could more resist wind break and -throw than denser ones and 3) The windfirmity of a stand was approximately in direct proportion to "$100^2/H\sqrt{N}$" as shown in Fig. 2., where H represented an average height and N the stemnumber per hectare, and the above coefficient was derived from statics of bending moment and edge stress on some assumptions.

For preventing stands from storm damages recomendations such as to be given are as follows: 1) by not decreasing the percent of broard-leaved trees mixed, 2) by selecting trees high enough to keep the average height lower and 3) by frequent and moderate-thinning on as short a cutting cycle as possible considering its intensity of the management, and also by a more positive determination of less growing stock in stem number within larger age classes per hectare than the usual standard.

105. Harmonic means in Bitterlich's sampling, Taneo HIRATA (Mics. Inform Tokyo Univ. Forests, 11, 9–14, 1956)

Since the expected number of trees g_i, whose frequency is f_i in the population of N trees, counted through Bitterlich's sampling is related with the expected total number of counted trees just proportionally to their basal area of $g_i f_i$ and $\sum^{s} g_i f_i (= G)$, the relative frequency of g_i in (Bitterlich's)-population regarded as such is formulated in the following manner:

$$P_{iB} = g_i f_i / \sum^{s} g_i f_i \quad \cdots\cdots (1)$$

When g_i is normalized by $t_i = (g_i - \bar{g})/\sigma_g$ and f_i/N is represented as P_i,

$$P_{iB} = P_i(1 + C_g t_i) : \quad \cdots\cdots (2)$$

or in case of diameter (d_i), from the above formula and the well known statistical relation of $C_g \fallingdotseq 2\,C_d$, the relative frequency of d_i in B-population is also followed by similar formulation as:

$$P_{iB} = P_i(1 + C_d \tau_i)^2 / (1 + C_d^2) \quad \cdots\cdots (3)$$

where $\tau_i = (d_i - \bar{d})/\sigma_d$.

Arithmetic and harmonic Means of g and d in B-population ($= g_{AB}$, g_{HB} and d_{AB}, d_{HB}) are resulted consequently as follows by conventional statistical computations through above formulae:

$$g_{AB} = \bar{g}(1 + C_g^2) \geqq \bar{g} \quad \cdots\cdots (4)$$

$$g_{HB} = \bar{g} \quad \cdots\cdots (5)$$

and $d_{AB} \doteqdot \bar{d}(1+3C_d^2)/(1+C_d^2)$ ....(6)

$d_{HB} = \bar{d}(1+C_d^2)$ ....(7)

Accordingly

$g_{dAB} = \bar{g}(1+3C_d^2)^2/(1+C_d^2)^3 \geqq \bar{g}$ ....(8)

$g_{dHB} \doteqdot \bar{g}(1+C_d^2) \geqq \bar{g}$ ....(9)

These values expected are in Table 1 shown in terms of C_d, and their reciprocals are shown as bracketed.

That P_{iB} is smaller or larger than P_i corresponding to

$$t_i \gtrless o \quad i.e. \quad g \gtrless \bar{g}$$

$$\text{or} \quad \tau_i \lesseqgtr (-1+\sqrt{1+C_d^2})/C_d \quad i.e. \quad d_i \gtrless \bar{d}\sqrt{1+C_d^2}(=d_g)$$

is shown in Fig. 1 explaining the relation of P_{iB} to P_i.

The total stem number per hectare $(=N)$ is estimated by $G/g_{HB}(=G/g)$, the approach to which is in itself as same as when the method published of summation of stem number per hectare on d_i are used.

Estimating total stem number per hectare with other means than $\bar{g}(=g_{HB})$ is always negatively biased to such a degree as shown by values bracketed in Table 1.

An error caused by rounding off or grouping diameter is truly in estimating the total stem number per hectare, rather negligible as far as the rounding breadth δ is smaller than about 1/3-time as the average tree diameter of basal area, and of course only in a distribution highly contacted at both ends of diameter, but the stem number per hectare by diameter class is estimated with positive bias on the left side of the mode in population and with negative one on its right side.

VII. Forest Products

Abstract Nos. 106—118

106. Veneering of chipboard. Shinji HIRAI and Yoshiyasu YAMAGISHI (Journ. Japan Wood Research Soc. **2**, 241-244, 1956)

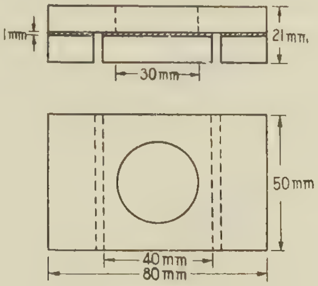
This paper deals with the testing method of adhesive strength of overlaid veneer to chipboard, and also with several gluing conditions by veneering of chipboard. The samples were mono-layer chipboards to which beech veneers (*Fagus crenata* BLUME) of several different thickness were applied, using a synthetic urea-formaldehyde-resin adhesive, usually a 20% solution of ammonium chloride being added to attain 5% in weight.

As one of the preliminary tests, Table 1 shows the comparison of two testing methods of adhesive strength between veneer and chipboard, using test pieces shown in Fig. 1. The authors consider that the delamination type is more appropriate and convenient than the shearing type to realize the gluing effect between chipboard and other materials.

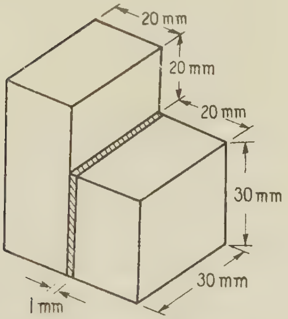
Table 2 shows the result of a delamination test of veneered chipboard, referring to thickness of veneer, and type of pressing, i. e. hot or cold process, and applied amount of adhesive, and another similar test referring to type of adhesive by hot-

pressed veneering was also carried.

The conclusion is as follows: In the case of veneering of chipboard with beech veneer using the above-mentioned urea-resin adhesive, it is effective to apply the adhesive in an amount more than 10 g per 900 cm^2 by the cold process and more than 5 g per 900 cm^2 by the hot process.



A. Delamination type



B. Shearing type.

Fig. 1. Two types of test piece for adhesive strength between veneer and chipboard.

Table 1. Comparison of two testing methods of adhesive strength between veneer and chipboard.

Type of pressing	Amount of adhesive per 30cm × 30cm on one side g	Delamination test		Shearing test	
		Delamination resistance kg/cm^2	Wood failure %	Shearing strength kg/cm^2	Wood failure %
Hot press	7.5	6.7	100	33.9	100
	15	6.6	100	23.3	100
	25	8.7	100	43.1	100
	35	8.7	100	51.3	100
Cold press	7.5	5.9	100	41.2	100
	15	6.8	100	38.2	100
	25	5.2	100	33.2	100

Moisture content of test piece: 8.6~9.9% by hot press, 8.8~10.6% by cold press.

Table 2. Results of delamination test of veneered chipboard referring to thickness of veneer, type of pressing and the applied amount of adhesive.

Thickness of veneer and type of pressing	Amount of adhesive per 30cm×30cm g	Delamination resistance kg/cm²	Wood failure %	Specific gravity at air dry	Quality quotient
4mm, hot press	2.5	4.4 (3.0~7.6)	90~100	0.51~0.52	8.6
	5	5.8 (4.3~7.3)	95~100	0.57~0.59	10.0
	10	6.4 (4.8~7.6)	100	0.59	10.9
	15	6.7 (5.3~8.5)	100	0.59~0.60	11.3
	20	6.5 (3.8~8.5)	100	0.58~0.59	11.1
4mm, cold press	2.5	2.1 (0.6~4.4)	0~ 80	0.52~0.55	3.6
	5	4.6 (2.6~6.3)	10~100	0.55	8.4
	10	5.7 (3.7~7.7)	95~100	0.54~0.61	9.9
	15	5.3 (2.6~8.2)	100	0.53~0.55	9.8
	20	6.2 (4.2~8.6)	100	0.54~0.57	11.2
2mm, hot press	2.5	3.3 (2.1~4.3)	80~100	0.53	6.2
	5	3.0 (1.9~3.9)	98~100	0.53~0.55	5.6
	10	3.1 (2.0~4.8)	100	0.57	5.4
	15	3.7 (2.9~4.5)	100	0.61	6.1
2mm, cold press	2.5	No bond	—	0.54	—
	5	2.0 (0.9~3.0)	0~100	0.55~0.56	3.7
	10	3.1 (2.3~4.2)	40~100	0.57~0.58	5.4
1mm, hot press	2.5	2.1 (1.3~2.6)	10~100	0.54~0.55	3.8
	5	2.7 (2.2~3.4)	60~100	0.58	4.7
	10	2.5 (2.0~3.3)	95~100	0.60~0.61	4.1
	15	2.7 (2.0~3.1)	50~100	0.56~0.57	4.8
1mm, cold press	2.5	1.0 (0.2~2.0)	0~ 90	0.51~0.52	1.9
	5	1.7 (0.9~2.0)	5~100	0.53~0.54	3.2
	10	2.2 (1.6~2.8)	90~100	0.55~0.56	4.0

Moisture content of test piece: 8.7~10.0% by hot press, 9.2~11.2% by cold press.

107. On the distribution of load at piled beam without binder. Kakuichi KITAHARA (Journ. Japan Wood Research Soc. **3**, 35-37, 1956)

In bending, the distribution of load on piled beams without binder will not be uniform, especially when the beams are made of wood which has no complete elasticity.

The author experimented on such load effects and put seven steel balls between two beams in two series as shown in Fig. 1. They indented into wood with load.

The relationship between load and indentation in the same raw material was known beforehand, and calculation of load applied could be made therefrom.

The distribution of load is as shown in Fig. 2.

The author calculated the deflection of the under beam with the distribution and Young's modulus which was obtained from other test pieces, and it was found that its value was almost the same as the empirical value.

The deflection of the under beam with load P is almost the same as that of a single beam with load P/2.

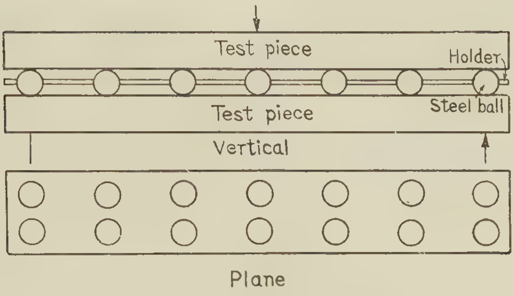


Fig. 1. Method of test

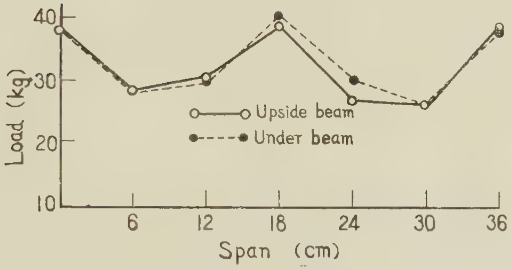


Fig. 2. Distribution of load (average value).

108. Studies on surface roughness of wood. Part 1. A simple apparatus for determining surface ronghness and methods for dealing with the results. Yôji KIKATA (Journ. Jap. Wood Research Soc. 3, 63–66, 1957)

The usual mechanically tracing and optical slit methods will not satisfactorily indicate some wood surface roughnesses quantitatively because of the surface disturbance by raised grain or wood pores. This being so, the author designed a simple apparatus for measuring surface roughness of wood or wooden materials. Tracing the wood surface by means of a rolling ball (0.4 mm), which is attached to the point of a dial-gage, all the peak-to-valley-heights of the measured surface can be recorded continuously. The values of peak-to-valley-height are arranged along a horizontal line, and a kind of profile curve will appear (Fig. 2).

Dealing with the resultant profile curves, the following two methods are applied.

1. "20 per cent roughness": A frequency curve of values of peak-to-valley-height is drawn from the profile curve (Fig. 3). The values at the point of 20% in area of the frequency curve from the maximum value is nominated "20% roughness", and this is one of the roughness indicators proposed by the author.

2. "Mean roughness": The other roughness indicator proposed by the author is "Mean roughness", which is the mean value of all the peak-to-valley-heights. In many cases the frequency curves of wood and wooden material surfaces are left-inclined and comprise extraordinarily large values, depending upon wood pores or construction characteristics.

Some trials to compensate "mean roughness" so as to reject extraordinary values

are shown in Table 2 and 3.

Generally speaking, "mean roughness" is more adequate than "20% roughness" for comparing various surfaces of wood and wooden materials.

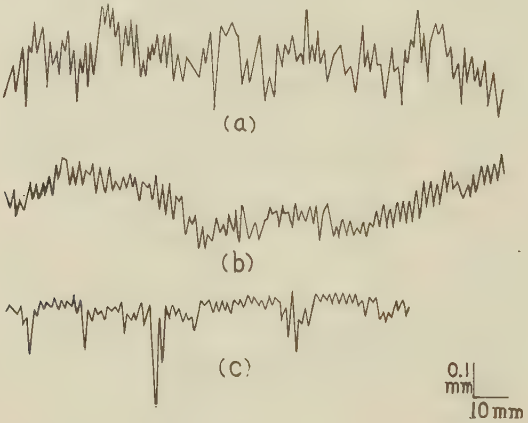


Fig. 1. Profile curves of surfaces by the simple apparatus.

(a) Chipboard, sawn end surface by circular rip-saw.
(b) Katsura, quarter sawn surface by band saw.
(c) Chipboard, sanded end surface.

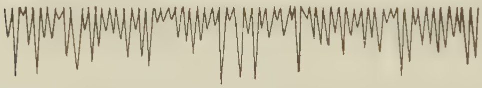


Fig. 2. Peak-to-valley-heights curve of Fig. 1 (a), sawn end surface of chipboard by circular rip-saw.

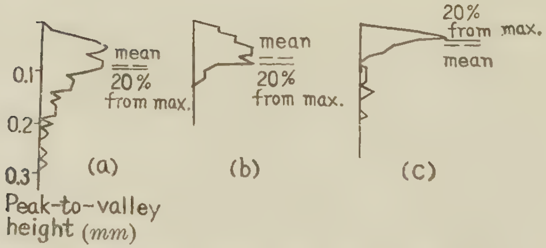


Fig. 3. Frequency curves of peak-to-valley-heights concerned to Fig. 1 (a) (b) (c).

(a) Chipboard, sawn end surface by circular rip-saw.
(b) Katsura, quarter sawn surface by band saw.
(c) Chipboard, sanded end surface.

Table 1. Roughness of wood.

Surface	Cutting surface by band saw (quarter sawn)				Cutting surface by circular saw (quarter sawn)			
Species	Sugi	Hinoki	Katsura	Buna	Sugi	Hinoki	Katsura	Buna
20% roughness 1/100 mm	6.5	5.5	7.5	4.5	4.0	3.0	2.0	3.0
Mean roughness 1/1.. mm	5.6	4.9	6.2	4.0	2.9	2.5	1.7	2.3
S-roughness (JIS)	70—S	50—S	70—S	50—S	35—S	25—S	18—S	50—S

Table 2. Roughness of end-surface of chip board by circular-saw cutting.

Compensation	No compensation			Values over 0.2 mm are converted into 0.2 mm		
Feeding speed m/min	6	3	1.5	6	3	1.5
Mean roughness 1/100 mm						
By cross-cut-saw	13.0	8.4	7.7	11.4	8.2	7.4
By rip-saw	8.4	7.3	6.2	8.2	7.2	5.9
By intermediate-saw	8.5	5.2	4.9	8.5	5.1	4.9
S-roughness (JIS)						
By cross-cut-saw	14.—S	100—S	100—S	140—S	100—S	100—S
By rip-saw	100—S	100—S	70—S	100—S	100—S	70—S
By intermediate-saw	100—S	70—S	50—S	100—S	70—S	50—S

Table 3. Roughness of plane surface of chipboard by sanding and hand-work planing.

Compensation	No compensation		Values over 0.1 mm are converted into 0.1 mm	
	Sanding	Hand-work planing	Sanding	Hand-work planing
Mean roughness 1/100 mm	3.6	2.7	3.3	2.6
S-roughness (JIS)	50—S	35—S	35—S	35—S

109. Studies on the finishing of wood. Part 1. The effect of filler on adhesion of paint film. Yoshihiko FUKUHARA (Wood Industry 11, 587-587, 1956)

It is well known that the function of wood filler is to provide a smooth surface on which is built the succeeding film finish.

In this case, however, adhesion of film may decrease. This paper deals on the adhesion of painfilm on the wood surface, especially on the effect of filler. The species tested was Shioji (*Fraxinus commemoralis* KOIDZUMI). The method of measurement of adhesion is similar to that of plywood.

Results obtained are as follows;

(1) The adhesion of shellac varnish film is stronger than that of lacquer film.

(2) The application of wood filler generally decreases the adhesion of paint film. But when the wood filler is removed from the wood surface by polishing after filling and is padded only in vessels, adhesion does not decrease. And when the gold-size filler is applied, the adhesion of lacquer film does not decrease.

(3) When the coating of lacquer and shellac varnish is applied before filling, adhesion of lacquer film does not decrease, for the shearing separation occures between the wood surface and the film finish. While in shellac coating, the separation occures at the inner part of film, and adhesion decreases.

Part 2. The effect of filler on adhesion of paint film (continued). Yoshihiko FUKUHARA (Wood Industry **12**, 273–276, 1957)

Previously, the adhesion of paint film on wood surface was investigated, especially on the effect of the filler, by methods similar to the adhesion test of plywood This paper deals with another method that has been investigated. The painted wood surface and celluloid plate of same size are jointed crosswise, adopting the "Sump" method. Adhesion tests are curried out on these jointed specimens. Species used are Shioji (*Fraxinus commemoralis* KOIDZUMI) and *red lauan.*

The results of this experiment are as follows;

(1) The adhesion of paint film on the polished wood surface is lower than the unpolished handwork-plained wood surface, for polishing dusts remain on the polished surface.

(2) The adhesion is not affected by the difference of grain-sizes of sander.

(3) The application of wood filler generally decreases the adhesion, but when wood filler is padded only in vessels the adhesion does not decrease.

(4) The adhesion value tested by this method is lower than the shearing test. But the tendency of the effect is similar.

110. Studies on the impact withdrawal resistance of nail in wood. (1). Shitomo MAMADA (Jour. Jap. Wood Research Soc. **2**, 217–220, 1956)

The apparatus for measuring the impact withdrawal resistance of nails is shown in Fig. 1, where CHARPY's 30 kg cm impact testing machine was used to withdraw the nail from the wood specimen S which was fixed on bed A, and the nail was pulled out the striking of pendulum G on bar D. The nails were 0.15-0.16 cm in diameter, 2.5 cm in length, and were driven into woods to a depth of 2.0-2.3 cm. The species of testing wood were HINOKI (*Chamaecyparis obtusa*) and SUGI (*Cryptomelia japonica*).

Some data obtained in this experiment are as follows:

1) The withdrawal resistance increased with increasing of driving angle, which was characterized by a rising curve. The empirical formulae are as follows:

$$y=52.4-0.96x+0.005x^2 \quad \text{(HINOKI)},$$
$$y=29.7-0.5x+0.0026x^2 \quad \text{(SUGI)},$$

where y is the impact withdrawal resistance (kg·cm) and x is the driving angle (°).

2) The relations between impact withdrawal resistance and moisture content of wood was characterized by a line very near to straight. The empirical formulae are as follows:

$$y=17.7-0.12x \quad \text{(HINOKI—tangential)},$$
$$y=8.2-0.055x \quad \text{(HINOKI—longitudinal)},$$
$$y=16.2-0.087x \quad \text{(SUGI—radial)},$$
$$y=7.4-0.056x \quad \text{(SUGI—longitudinal)},$$

where y is the impact withdrawal resistance (kg cm) and x is the moisture content (%).

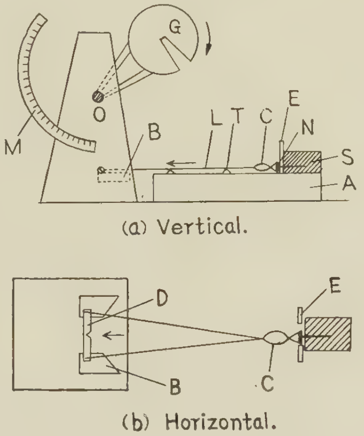


Fig. 1. Apparatus for measuring the impact withdrawal resistance of nail.

3) It is assumed that the energy of static withdrawal resistance is a little larger than the impact.

111. A study on judgement method of relative water contents in green disks of todo-fir by γ-ray. Noriyoshi IIZUKA rnd Saburo SAKAMOTO (Journ. Japan Wood Research Soc. **3**, 14–19, 1957)

Penetrability of γ-ray of radioactive istope Co^{60} through green disk of todo-fir and its correlation to water content of wood was studied. The strength of the penetrated ray (counts/min) was measured by G-M counter and absorption counting rate was given as a difference between that value and a value obtained without disk. The measurements were carried out along the diameter passing through the pith, on the positions established at an equal distance from one another. The test pieces were cut off from the disk on the above described measurement positions, and water contents in each piece was estimated. Comparisons on distribution curves of the absorption counting rate and water content in the two radial directions which were at right angle to each other were made on 22 disks (15 cm thick, mainly water-rich and knot-free). The test results show that the absorption counting rates are in general highly correlative to the water content. However, the thickness in

fiber direction (3 cm) of water content test pieces and passing distance of γ-ray (15 cm) were not equal. The effect of thickness difference between the test pieces and the radiated disks on the above correlation was not clearly recognized in the test results on the disks of various thickness (3, 5 and 10 cm). When the direction of γ-ray has larger angle against that of the fiber direction of disk, absorption counting rate is not highly correlative with the water content but is correlative with the density of wood through which γ-ray penetrates. From the above results, it seems that some of the causes by which ray absorption and water content are not exceptionally correlative, are thickness difference of disk and test piece, and the disorder of fiber direction in the neighbourhood of knot.

112. Study on the judgement method of inner rot of living trees (todo-fir) by γ-ray. Noriyoshi IIZUKA (Bull. Tokyo Univ. Forests 52, 143–163, 1956)

This study has been carried out to detect the decay in the trunk of todo-matsu (*Abies mayriana* MIYABE et KUDO) without any destructive means. The method employed here is based on the principle that the penetration of γ-ray through decayed wood is easier than that through sound one as a result of the density reduction by decay. To make easy the practice of out-door measurement, radio isotope Co^{60} was used as the source of γ-ray and the portable rate meter with the several attachments was applied on counting ray which passed through the tree trunk.

The ray countings on each trunk were done moving gradually the penetration path from one side to the other along a transverse direction of trunk and were repeated in the same way along another transverse direction which is at right to the above. The existence of decayed portion and the other something wrong part in trunk were estimated comparing the ray counts distribution to the average one of sound trunks which is previously obtained. The hit-percentages of the detections for thirty-four trees in the natural forest were as follows;

	Below 0°C	Above 0°C
Decayed tree	75%	93%
Sound tree	80%	100%

The caution should be taken, however, on the distribution of water content in trunk which was found to affect on the ray counts and sometimes disturve the judgement.

113. Constitution of the inorganic components in the seed of forest trees of Japan. Takeo SHIBAMOTO and Haruji NAKAZAWA (Jour. Jap. Forestry Soc., **39**, 207–213, 1957)

The inorganic components of the seeds of *Cryptomeria japonica* DON. and *Pinus densiflora* S. et Z. produced in 1953, those of *Cryptomeria japonica* DON., *Chamaecyparis obutusa* SIEB. et ZUCC., *Pinus Thunbergii* PARL. and *Quercus acutissima* CARR. produced in 1954, and those of *Pinus densiflora* S. et Z., *Larix Kaempferi* SARG., *Zelkowa serrata* MAKINO and *Fraxinus mandshurica* RUPR. produced in 1955 were analysed.

The results obtained from these analytical experiments may be summarized as follows;

The seeds of *Cryptomeria japonica* DON. and *Chamaecyparis obutusa* SIEB. et ZUCC. contain extraordinarily large amounts of calcium in addition to the other components, and they show the maximum ratio of calcium to magnesium among the other tested seeds.

On the other hand, the seeds of *Pinus densiflora* S. et Z., *Pinus Thunbergii* PARL. and *Larix Kaempferi* SARG. contain especially large amounts of silicic acid, magnesium, mangan, phosphoric acid and nitrogen, and indicate the minimum ratio of calcium to magnesium.

The seed of *Zelkowa serrata* MAKINO shows a component ratio different from the seeds of *Quercus acutissima* CARL. and *Fraxinus mandshurica* RUPR., that is to say, the seed of *Zelkowa serrata* MAKINO contain much more silicic acid, magnesium and calcium, though the others contain a few of those components but remarkably much of potassium.

Finally, it may be concluded that *Cryptomeria japonica* DON. has seeds rich in calcium and phosphoric acid; *Pinus densiflora* S. et Z. and *Pinus Thunbergii* PARL. has seeds having much of magnesium and silicic acid; *Larix Kaempferi* SARG. has seeds abundant in phosphoric and silicic acid; *Quercus acutssima* CARR. has seeds with much potassium; *Zelkowa serrata* MAKINO has seeds chiefly rich in calcium and silicic acid, and *Fraxinus mandshurica* RUPR. seeds that are rich in potassium and phosphoric acid.

114. Pulping with hydrotropic solutions. Part 2. Relation between the chemical structures of hydrotropic salts and their delignification effects. Nobuhiko MIGITA, Junzo NAKANO, Seiya HIRAI & Chiyoko TAKATSUKA (Journ. Soc. Textile & Cellulose Ind., Japan. **12**, 632, 1956)

For extraction of lignin from plant materials hydrotropic solutions were suggested by R. H. McKee (1946). In this paper pulping effects of nine kinds of hydrotropic salts were compared on beech and spruce wood. The salts employed in tihs study were as follows: sodium benzene soulfonate, sodium toluenesulfonate, sodium xylenesulfonate, sodium mesitylenesulfonate, sodium ethylbenzenesulfonate, sodium butylbenzenesulfonate, sodium cymenesulfonate, sodium butylsulfonate and sodium octylsulfonate. These were adopted from the consideration of their chemical structures. All the salts used were synthesized. The elemental analyses of the salts proved them to be very pure.

Wood flour samples extracted with alcohol-benzene 1:2 were cooked with aqueous solutions of the hydrotropic salts of various concentrations (35, 25 and 15% in weight) at 160°C for 6 hours.

Of the nine salts sodium cymenesulfonate, sodium butylbenzenesulfonate, sodium ethylbenezenesulfonate and sodium xylenesulfonate were more effective than the others. The order of delignification ffect of the inferior salts were as follows: sodium toluenesulfonate, sodium octylsulfonate, sodium benzenesulfonate and sodium butylsulfonate. The effect of sodium mesitylenesulfonate seemed to be abnormal. Softwood lignin cannot be removed with a hydrotropic solvent so easily as hardwood lignin. Sodium cymenesulfonate, however, showed a considerable hydrotropic effect, even to spruce lignin.

From the results given above, the following conclusion may be drawn. Of the homologous series of seven derivatives of sodium benzenesulfonate, the hydrotropic effect to lignin increases with increasing in number and in size of alkyl groups attached to the benzene nucleus. The delignification effect of alkylarylsulfonate is larger than that of alkylsulfonate. No difference was recognized practically among the hydrotropic effects of eight salts to carbohydrates.

The authors reported that the dissolution of lignin with a hydrotropic solution may take place in two steps. In the first, the lignin is changed by the action of hot water at cooking, and in the second the lignin so altered is dissolved in the hydrotropic solution (J. Japanese Forestry Soc., **36**, 343, 1954). In order to confirm this conclusion, a series of cooking experiments were carried out. Namely, wood flour samples were cooked by a 35% sodium xylenesulfonate solution from one to three times (at 100°C, 2 hours), with or without water pre-cookings (160°C, 1 hour). The result indicates that the water pre-cooking promotes considerably the effect of hydrotropic solution to lignin. This may offer an evidence to the conclusion in the preceding paper.

115. The reddening of unbleached hardwood sulfite pulp. Junzo Nakano, Kimio Hirakawa, Katsuaki Takebe & Nobuhiko Migita (Journ. Japanese TAPPI., **11**, 105, 1957)

The fact that the unbleached sulfite pulp gives a red color was recognized about thirty years ago. This phenomenon has been studied by several investigators on the softwood pulps, but not on the hardwood pulp. Though the unbleached sulfite pulp prepared from hardwood gives also a more or less distinct red color, the reddening of hardwood pulp somewhat differs from the reddening of softwood pulp. The reddening of softwood pulp appears in the course of storage, while the reddening of hardwood pulp appears immediately in the course of washing of pulp discharged from a diester. In this paper some studies are given on the reddening of hardwood sulfite pulp.

Sulfite pulps were prepared from seven kinds of hardwood (poplar, alder, birch, beech, oak, maple and lime). They were left for seventy hours to stabilize the red color appearing on the pulps and then the degree of reddening of pulp was determined by the EPIC spectrophotometer against a magnesium oxide plate.

The red color of pulp was the most pronounced in cases of birch, maple, lime and alder. The red color gives a reflection minimum at ca. 500 mμ, though the red color of softwood pulp gives a reflection minimum at 510-520 mμ. It seems that this coloring matter is already produced after the first half of the cooking period, and thereafter the two reactions, the production and the decomposition of the coloring matter take place simultaneously. The deepness of red color is not always proportional to the lignin content of pulp.

The reddening of softwood pulp is considered to be caused by the lignosulfonic acid (or the product derived from it) in pulp. The same conclusion may be drawn from the following facts in case of hardwood pulp. (1) The red color can be also observed on the pulp prepared from birch wood free from extractives. (2) The red color cannot be observed on the pulp prepared from spruce wood (the spruce sulfite pulp did not give the red color in the authors' experiment) impregnated with

the extractives of birch wood. (3) The pulp prepared from spruce wood impregnated with the solid lignosulfonic acid obtained from birch wood, gives a pink color. The presence of heavy metal ion promotes the reddening of pulp. Bleaching powder and sodium chlorite are effective to remove the red color appearing on pulp. The color can be also removed by treatment of hot water or aqueous solution of sodium hydroxide, whose concentration is more than 5 milli mol/L.

116. On the mechanism of color reaction of lignin. Part 4. The Mäule color reaction (3). Junzo NAKANO, Kimio HIRAKAWA, Atsushi ISHIZU & Nobuhiko MIGITA (Journ. Japan Wood Research Soc., 3, 23, 1957)

Among the isolated lignins from beechwood meal, the hydrochloric acid lignin gives the most distinct Mäule color reaction similar to that of protolignin. The hydrochloric acid lignin fully methylated with $(CH_3)_2SO_4$ or reduced with $NaBH_4$ is also positive in the Mäule test.

The hydrochloric acid lignin treated with 1% $KMnO_4$ and then 3% CH1 is insoluble in alcohol, but becomes soluble in alcohol or dioxane if this oxidized lignin is methylated with 1.25 N methanolic hydrochloric acid. The yield of the methylated oxidized hydrochloric acid lignin is about 35% of the original lignin.

The alcohol solution of methylated oxidized lignin gives the positive Mäule coloration by the addition of ammonium hydroxide. Its absorption spectrum in the visible region is maximum at 530 mμ and minimum at 430 mμ. The infrared absorption spectrum of methylated oxidized lignin shows much increase in the carbonyl and carboxyl groups (absorptions around 5.85 μ and 6.1 μ) and the destruction of aromatic nucleus (absorptions around 6.3 μ and 6.7 μ), compared with that of original lignin.

When the methylated oxidized lignin is hydrogenated at atmospheric pressure, the color given by the Mäule test becomes only slightly weak, whereas the color given by the phloroglucinol-HC1 treatment becomes remarkably weak, when the lignin sample (Brauns' native lignin) is hydrogenated in the same manner. The hydrogenation under pressure (3 Kg/cm^2) makes the methylated oxidized lignin negative in the Mäule test.

From these results, the mechanism of Mäule color reaction may be summarized as follows. The ketone group at α-position in the side chain of lignin molecule, which is newly produced by the treatments of $KMnO_4$ and then HC1, is responsible for the Mäule color reaction. The aldehyde group and double bond in the side chain, however, are not concerned in the color reaction.

117. Research on the swelling of fibers. Part 2. Relation between the swelling property of hardwood pulp elements and the microstructure of their secondary cell wall. Nobuhiko MIGITA and Hayao HOSOI (Bull. Tokyo Univ. Forests, 52, 119–134, 1956)

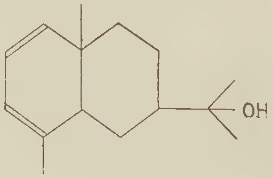
For the purpose of examining the characteristic behaviors of hardwood pulp elements (wood fiber, vessel and ray parenchyma cell) in the course of swelling, beech wood pulp elements prepared by screenings were subjected separately to the swelling test proposed by the authors. To help the consideration of the results of the swelling test, some electron microscopic observations were made on the secondary cell walls of

the elements. The results are as follows:
(1) The wood fibers and their fragments above 200 mesh swell in phosphoric acid in the same way as the tracheid of soft wood does. The smaller fragments (200-300 mesh) afford no balloon swelling, but split into several strips parallel to the longitudinal cell axis.
(2) The vessels do not swell in phosphoric acid so easily as wood fibers. Namely the cell walls scarcely increase in thickness, and afford no balloon swelling. This may support the view that the outer layer (S_1) and the inner layer (S_3) are dominant in thickness in the secondary cell wall of vessels, and the middle layer (S_2) is thin even if it exists. The existence of the middle layer was recognized for the first time by the authors' electron microscopic observation. The results show that the secondary cell wall of vessels consists of three layers (S_1, S_2 and S_3), and their fibrillar orientations are 90°, 40° and 90° to the longitudinal cell axis, respectively.
(3) The results of the swelling test show that ray parenchyma cells may be devided into two types, the fusiform and the rectangular. The fusiform cells afford baloon swelling, though balloons appearing on the cell walls are a few (one or two). This may indicate that the composition of the secondary cell wall of the fusiform cells is simillar to that of wood fibers. The existence of three layers (S_1, S_2 and S_3) in the secondary cell walls of these cells were recognized for the first time by the authors' electron microscopic observation. The fibrillar orientation of the three layers are 60°, 0° and 60° to the longitudinal cell axis, respectively.

While swelling, the rectangular cells split into several strips parallel to the longitudinal cells axis. This suggests that in the secondary cell wall the layers, whose fibrillar orientation is parallel to the longitudinal cell axis, are dominant in thickness.

118. Terpenoids. Part 1. The structure of occidentalol, a new sesquiterpene alcohol from *Thuja occidentalis* L. Tomoichiro NAKATSUKA and Yoshiyuki HIROSE (Bull. Agr. Chem. Soc. Japan **20**, 215–218, 1956)

A new sesquiterpene alcohol, $C_{15}H_{24}O$ m.p. 95°C, named occidentalol, has been isolated from the essential oil of the wood of *Thuja occidentalis* L. This compound has a carbon skeleton of eudalene, one tertiary alcoholic group, and two ethylenic linkages which are conjugated. The structure of this compound was proposed as formula (I).



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VIII. Zootechnical and Veterinary Science

Abstracts Nos. 119—133

119. Variation of the mammary growth response of inbred female mice treated with estrogen. Jiro NAGAI, Junzo YAMADA, Motokazu YOSHIDA, Tateki CHIKAMUNE and Motoo NAITO (Endocrin. Japon., 4 [1], 12–16, 1957)

Variations in mammary growth response and corrected mammary growth response of inbred female mice with estrogen treatment were investigated in comparison with those of mice which were randomly inbred for a short time. All mice tested were injected with a total dose of 12.5 I.U. of synthetic estrogen five times from the 20th day of birth every third day. Mammary growth response was manifested in the mammary area of mice treated with estrogen, and corrected mammary growth response was obtained using the regression of mammary growth response on body weight on the 35th day of birth.

It seemed to be plausible that inbred mice did not show more uniform response in respect to both mammary growth response and corrected mammary growth response than the mice which were bred randomly and inbred for short time. Therefore, it was concluded that the use of inbred mice itself might not be necessarily preferred to that of mice which have been kept without inbreeding in respect to variation of a character chosen to be of the type measured in bio-assay.

120. Establishment of inbred mice strains with reference to mammary growth response to estrogen treatment —Changes of variation— Jiro NAGAI, Motokazu YOSHIDA and Motoo NAITO (Jap. Journ. Breed., 7, Suppl., 23, 1957)

Breeding experiments were carried out for the purpose of ascertaining the possibility of establishing inbred mice strains with less variabilities concerning to the mammary growth response, which is considered to be a character belonging to the "properties of the organism as a whole".

Brother-sister mating system was adopted and selections for less variabilities, on the basis of mammary growth response of progenies, were carried out at the random mating stage and in the 2nd generation. The changes in such factors as means and variabilities of mammary growth response, body weight and corrected mammary growth response for body weight on 35th day of age were observed up to the 6th generation.

Results obtained are as follows:

1) Means of three characters increased gradually.
2) There were no definite tendency concerning the gross variances of three characters but coefficients of variation decreased gradually.
3) Variations within families, composed of brother and sister, did not change in a definite manner. However, coefficients of variation within a family did decrease gradually in the course of the proceeding generation.

Inbreeding, selection for less variabilities of mammary growth response and un-

controlled environmental factors will play an important role, while the essential factor for these changes of variabilities is still not certain.

121. Interrelationship between mammary growth response and body weight in female mice treated with estrogen. Jiro NAGAI, Motokazu YOSHIDA and Motoo NAITO (Jap. Journ. Zootech. Sci., 28, Suppl., 42, 1957)

The relation between mammary growth response: to contant dose of estrogen (M), body weight on 35th day (W) and corrected mammary growth response for body weight (C) was investigated.

Numbers of mice used were 259, born from 52 dams, and they were at the 3rd generation of full-sib mating. They were injected five times subcutaneously with a total dose of 12.5 I.U. of synthetic estrogen every third day from the time they were 20 days old. On the 35th day, the mice were killed after weighing the body weight.

Heritabilities estimated from analysis of variance were 0.32, 0.36 and 0.25 in M, W, and C respectively at the 3rd generation. Relationship between the three characters were 0.62, 0.88 and 0.39 in r_{WM}, r_{MC} and r_{WC} phenotypically, and 0.86, 0.63 and 0.44 genotypically.

In conclusion; mammary growth response is a heritable character as much as body weight and close genetical relationship between body weight and mammary growth response is present.

122. Mammary growth responses of inbred mice and their hybrids. Junzo YAMADA, Jiro NAGAI and Motoo NAITO (Jap. Journ. Zootech. Sci., 28, Suppl., 42, 1957)

The mammary growth responses in mice treated with estrogen were tested in bc and C strains, their reciprocal hybrids and reciprocal hybrids between bc and Swiss.

The mice of each group were injected every third day subcutaneously five times with a total dose of 12.5 I.U. of esrogen from the 20th day of birth. On the 35th day the mice were weighed and the mammary growth responses were examined.

Results obtained are as follows.

1) Hybrid mice showed heterosis on body weight, especially in the female hybrid of bc$\times$C. Their variance seemed to have no definite tendency, but the coefficients of variation of body weight in hybrids were a little smaller than the inbreds.

2) Similarly, hybrid mice showed heterosis on mammary growth response, but the increasing rates of mammary growth responses in hybrids widely varied among hybrid groups. Variances of hybrid mice seemed larger than inbreds, but the coefficients of variation of mammary growth response were not always larger.

3) The coefficients of correlation between body weight and mammary growth response was found to range from $+0.648$ (female offspring of C$\times$bc) to -0.262 (male offspring of bc). The reason why the values of male mice were generally low depends probably on the fact that the mammary growth responses of male mice were frequently near zero and the distributions were far from normal distribution.

123. Mammary growth responses of the inbred Kasukabe mice treated with different doses of estrogen. Motokazu YOSHIDA, Jiro NAGAI and Motoo NAITO (Jap. Journ. Zootech. Sci., 28, Suppl., 42, 1957)

The study was carried out to investigate whether the dosage used in the study on the establishment of two inbred mice strains with reference to different mammary growth responses was that responsible for the maximum mammary growth responses in the inbred Kasukabe mice and whether there were any differences in the response between intact and castrated mice treated with estrogen.

The mice used were those of four and five generations of full-sib mating. A total 160 mice were divided into five classes and each class consisted of 8 intact and 8 castrated mice of both sexes. They were injected subcutaneously with a total dose of 3.175, 6.25, 12.5, 25 and 50 I.U. of estrogen. Castration was performed on the 19th day of age. The other methods used were the same ones in the main study.

The results from the analysis of variance are as follows:

1) There was no difference in the mammary growth response between intact and castrated mice in each sex.
2) There was significant difference in the response between sexes.
3) There was significant difference in the response between dosages in castrated female mice and a parallel relationship was found between lower dosages than 12.5 I.U. and mammary growth responses. However, there was no difference in the mammary growth responses between 12.5, 25 and 50 I.U. dosages with the highest results.

In conclusion; these results indicated that in the mice of four and five generations of full-sib mating the dosage (12.5 I.U.) used in the study on the establishment of two inbred mice strains was that responsible for the maximum mammary growth response and there was no difference in the responses between intact and castrated mice treated with that dosage.

124. The effect of locally administered prolactin on the nucleic acid content of the mammary gland of rabbit. Hideo MIZUNO and Motoo NAITO (Endocrinol. Jap., 3 [4], 227–230, 1956)

Ovariectomized virgin rabbits were injected with prolactin. Three pairs of the mammary glands, two abdominal and one inguinal, were used in each animal. Prolactin in doses of 1, 3, 5 or 10 i.u. per day dissolved in 0.3 cc of distilled water was injected every other day for a period of 10 days into a galactophore of one of the pairs of mammary glands, the contralateral gland being used as control. The animals were killed on the second day after the last injection and the mammary glands were removed. The whole gland was homogenized with ice-cold distilled water and nucleic acids were extracted by the method which was essentially described by Schneider. DNA was determined by the diphenylamine reaction of Dische as modified by Yagi, and RNA by the orcinol method described by Majbaum.

Mammary glands which received prolactin intraductally, contained significantly larger amounts of nucleic acids than the contralateral untreated control glands in the same animal. The average rates of increase were 20-50% in DNA, and 80-120% in RNA.

This fact suggests that prolactin stimulated the mitotic activity of the mammary gland and promoted the alveolar formation.

125. Influences of hypophysectomy in mice. Part 3. Effects upon the ovary, uterus, vaginal epithelium and adrenal of the female mice. Koshi MOCHIZUKI and Shiichi NISHIDA (Jap. Journ. Zootech. Sci., 28 [1], 40–48, 1957)

In order to clarify the normal involutionary changes in the reproductive organs and adrenals which occur as results of hypophysectomy, a histological study on these organs of hypophysectomized femal mice was performed. Twenty immature and twenty-eight mature mice of the bc strain were subjected to hypophysectomy and autopsied at various periods ranging from 1 to 159 days after hypophysectomy. At operation, the immature mice were 28 to 30 days of age, and the mature ones 2 months of age. At autopsy, the organs to be studied were all dissected from the surrounding fatty connective tissue, weighed and prepared for histological studies. The fixatives and staining methods employed were the same as those described in our previous reports, except for some cases in which the organs were fixed in chilled 80% alcohol and stained for alkaline monoglycerophosphatase by Gomori's technic.

Following hypophysectomy there was a fall in body weight. The reproductive organs and adrenal glands regressed in weight and underwent a pronounced atrophy. The changes in organ weights are summarized in tables 1 and 2.

Ovaries: A very rapid regression in size of those ovaries took place. Thus there has been a loss of some 50% in weight on the 10th day after hypophysectomy. The first structures to show significant changes after hypophysectomy were large and medium sized follicles. Signs of atresia began to be seen as early as 24 hours, showing clumping of chromatin and achromatolysis of the granulosa cells. Later the thecal cells underwent atrophy, the ovum degenerated and on the 5th day no large follicles remained. Small follicles showed a gradual decrease in number and very few were seen on the 25th day, the ovary becoming to be filled with stromal cells. However, growth of the primordial follicles did not cease. They might develop to the beginning stage of antrum formation, because in the granulosa cells of the small follicles, although not numerous, mitosis were often seen. In the ovaries of prepuberally operated mice, pituitary defficiency manifestations were also evident, since advanced stages of follicular maturation did not occur in any case. The most interesting fact about alkaline phosphatase which has emerged from this study is that all follicles of varying size develop large quantities of the enzyme in the granulosa layer which is normally almost devoid of activity.

Ovarian stroma: The ovarian stroma of the operated mice was composed of a highly cellular tissue with densely staining nuclei. The nuclei underwent a retrogressive process designated as "wheel cell formation".

Corpola lutea: When corpora lutea were present, a process of degeneration began within 5 days and ended by the 20th day after the operation. Corpora lutea of pregnancy in the mice operated at mid-pregnancy, however, looked quite normal at the end of gestation.

Uterus and vagina: After the operation, the uterus atrophied to a small and compact structure, very similar to that found in the spayed animals. The vaginal epithelium underwent a pronounced atrophy and the epithelium consisted of two layers of cells only.

Adrenal gland: The adrenal glands underwent cortical atrophy to a marked

degree and their individual cells decreased in size. The histological changes produced by hypophysectomy in the adrenal glands were almost the same as those described in our previous papers, but were somewhat prominent in females. It is of considerable interest that after operation, alkaline phosphatase developed in the adrenal medullary cells, which is normally devoid of activity in them.

126. Electromyographic studies on the function of the skeletal muscle. Part 4. Effect of training on the function of the skeletal muscle (2). Hichiro INADA (Jap. Journ. Vet. Sci. **18**, 63–69, 1956)

The problem in this experiment is what effect of training is exerted upon each muscle activity and their cooperation in keeping the standing posture on the moving forward-inclined board. For this purpose, one dog was trained to the above-mentioned conditioning and another was untrained. Continuous electromyographic recordingss of single NMU were taken from the plantaris, the gastrocnemius, the flexor carpi ulnaris and the extensor carpi ulnaris of each subject throughout for 3 stages: the inclination-increasing stage from 8° to 16° (Stage I), the holding stage at 16° (Stage II) and the inclination-decreasing stage from 16° to 8° (Stage III), and the angular velocity was about 1°/sec in each case. Variation of discharge intervals of single NMU was separated into two components: the slow undulation and the irregular fluctuation, and the results obtained are summarized as follows.

1) The slow undulation

The amplitude of the slow undulation is less in the plantaris, the gastrocnemius and the flexor carpi ulnaris of the trained dog than for the untrained. On the contrary, the slow undulation of the extensor carpi ulnaris is rather more striking in the trained than in the untrained. However, marked differences are not recognizable between either subject concerning the basic form of the slow undulation of each muscle.

2) The irregular fluctuation

Generally speaking, $\bar{\tau}$ (the average of discharge intervals) and S (the standard deviation of the irregular fluctuation) of the trained is larger in the plantaris and the gastrocnemius than in those of the untrained, regardless of difference of stage. The direction of the change from Stage I to Stage III of the $\bar{\tau}$-S point is both definite and identical in the plantaris and the gastrocnemius, irrespective of training, but big changes occure sometimes in the untrained. $\bar{\tau}$ and S of the flexor carpi ulnaris of the untrained are larger than those of the trained and also the range of variation of these statistics is wider, and the direction of the change of the $\bar{\tau}$-S point is indefinite in the flexor carpi ulnaris of the untrained, though the direction is definite in the trained. The trained has larger $\bar{\tau}$ and S in the extensor carpi ulnaris.

While training to maintain a stance exerts a simple effect upon muscle activity, that is, diminution of the irregular fluctuation, training to keep the standing posture on the moving forward-inclined board brings about far more complicated effects upon both the slow undulation and the irregular fluctuation and furthermore upon the cooperation of muscle activities.

Part 5. Functional change of the skeletal muscles accompanied by the development. Noriji TABA and Hiroaki SHISHIDO (Jap. Journ. Vet. Sci. **19**, 97–99, 1957)

This experiment was designed to investigate the functional change of skeletal muscles accompanied by development and was performed on two brood puppies. Electromyographic recordings of a single neuromuscular unit (NMU) were taken from the gastrocnemius, the quadriceps femoris, and the supra spinam of each subject, in the standing posture, once a month from the age of 2 months to the age of 8 months. The discharge intervals of a NMU were measured and analysed according to the formal method. Each discharge-interval-time-series was divided into the two components: the slow undulation and the irregular fluctuation. Taking into consideration the discharge pattern, these components were discussed.

Results are as follows:

1) In the early period of the development, the unusual pattern (which resembled to the syntonization voltage) is often observed, but in the late period this pattern is scarcely observed.

2) The amplitude of the slow undulation decreases gradually according to the progress of the age, and furthermore, the process of the slow undulation gets stable and rhythmical. From these facts, it is clear that the muscle activity to maintain the standing posture is stabilized as the age increases.

3) Compared to the $\bar{\tau}$-S curve at the age of 2 months, the $\bar{\tau}$-S curve at 4 months ($\bar{\tau}$: the average of the discharge intervals, S: the standard deviation of the series of the irregular fluctuation) is displaced to the left side in all muscles, but on the contrary, the $\bar{\tau}$-S curves at 6 and 8 months are displaced to the right side. It is presumed that the displacement to the left side, shown in the early period, results from the development of the nervous system, especially the cortex motor area, and the displacement to the right side, shown in the late period, results from the training of the muscles.

4) The same change is brought about by the development in every muscle, but the grade of change is different due to the kind of muscle.

127. Electromyographic study of postural adjustment. Part 2. Maintenance of various standing postures and vision. Hichiro Inada (Jap. Journ. Vet. Sci. **19**, 1–7, 1957)

This experiment was made with the object of examining to what extent the disturbance of muscle action, which was required for the miantaining of various standing postures, was brought about by the elimination of vision. Using two dogs, electromyographic recordings of successive discharges of single NMU were taken from the gastrocnemius, the biceps femoris, the quadriceps femoris and the flexor carpi ulnaris under four conditions: NV (the normal standing with vision), NN (the normal standing without vision), TV (the tripedal standing with vision) and TN (the tripedal standing without vision). Dogs were blindfolded by double black cloth when without vision, and were subjected to 3 or 4 repitition under each condition on different days.

As a rule, the variation of the time series of discharge intervals is separable into two components: the slow undulation and the irregular fluctuation, and, therefore, discussions were made on the respective components.

(1) The variation of discharge intervals tends to be augmented a little by the visual elimination but this tendency is not highly distinguishable.

(2) The visual elimination has marked effects on the slow undulation, but the

extent of their manifestation is not uniform, that is, it is different according to kinds of postures and muscles involved. In the normal standing posture, the process of the slow undulation becomes rhythmic in some muscles but in others it is subjected to only slightly noticeable changes. As a rule, when without vision, the amplitude of the slow undulation increases markedly, especially in the tripedal standing posture, and the process of the slow undulation becomes strikingly unstable in the tripedal standing one, regardless of designation of muscle. Furthermore, in the tripedal standing posture, the effects of the visual elimination are more remarkable in the muscles which are concerned in the fixation of mechanically unstable joints like the knee joint, than in those which fix mechanically stable joints like the hock joint, that is, the former is more dependent upon vision to maintain stable muscle action than the latter. Thus, it follows that the manifestation of the effects is more striking in the tripedal standing posture than in the normal standing one. This indicates that the visually conducted adjustment of muscle action is more important in the insecurity of the bodily balance like in the tripedal standing posture.

(4) It seems that the visual elimination has no effect on the irregular fluctuation.

From these results, it has been demonstrated that stable maintenance of the various standing postures, especially the asymmetrical standing one, depends upon vision to a considerable extent.

128. Factors neccessary for E. tenella infection on the chicken. Part 3. Influence of the upper alimentary canal on infection. Miyoshi IKEDA (Jap. Journ. Vet. Sci. 18, 25–29, 1956)

Concerning the possible actions of the alimentary canal on E. tenella infection in the chicken, it was recently reported that the liberation of the sporozoites from oocysts was brought about by the mechanical action in the crop and the gizzard, contrary to the view commonly held that the action was due to some enzymes present in the digestive juices. In view of the fact that there is little information on this point, it is hardly possible, at present, to come to any definite conclusion with regard to E.tenella infection.

In the previous papers it was demonstrated that the pancreatic juice was an important factor necessary for E.tenella infection in the chicken. In this paper, however, the author describes further experiments which were carried out because such discrepancies mentioned above made it desirable to know what effect the upper alimentary canal (crop, proventriculus, gizzard), alone, has on the infection of E.tenella in chickens.

1. In order to observe the changes of the sporulated oocysts of E.tenella in different parts of the upper alimentary canal other than the gizzard, oocysts were introduced into the following pouches which were prepared by ligating a part of the crop, proventriculus or gizzard, respectively. One-two hours or, in some cases, one-two days after the introduction of the oocysts, microscopic examinations were made which indicated the following results.

In general, although swelling, folding and rarely rupture of the membranes of some oocysts could be observed, it was impossible to ascertain the digestive evidence of liberation of sporozoites from the oocysts under special experimental conditions.

2. Further attempts were carried out to know the possible effects of only the crop or gizzard by a method using chickens from which the crop or gizzard was surgically removed, respectively, and were inoculated by introducing oocysts by a rubber tube inserted per os.

In both cases, the infection in the chickens so operated on, was similar to the infection found in the normal chickens.

3. In the hope of obtaining decisive evidence or the possible effects of only the upper alimentary canal, without the action of the lower intestine other than the duodenum, an attempt was made, in which a distal part of one side of the caeca was sected and the end of the caecal segment was transplanted into the upper portion of the duodenum. It was ascertained, through the preliminary experiments, that 4-5 days after operation the intestinal contents passed down from the gizzard to the duodenum, and entered into the transplanted caeca and the contents were found to be quite different from those of the normal caeca, indicating the similar appearance and filling of those of the duodenum and, in addition, the transplanted caeca was capable of supporting E.tenella growth.

None of the transplanted caeca became infected, in spite of infection of the unoperated side of the caeca, when dosed with sporulated oocysts of E.tenella.

From the data presented here, it seems that the upper alimentary canal, other than the gizzard, is not necessarily essential for E.tenella infection in the chicken, though there remains the possibility of such a minor role, as the more rapid effects of duodenal juices or pancreatic juices after exposure of the oocysts in the upper alimentary canal. This point will be reported after further experiments.

Part 4. Investigations of the site of the action of the pancreatic juice on infection. Miyoshi IKEDA (Jap. Journ. Vet. Sci. 18, 45-51, 1956)

Investigations were carried out to clarify the site of the action of the pancreatic juice on E. tenella infection in the chicken.

From the results reported, none of the chickens with the ligated pancreatic ducts became infected, and these negative results led the author to question whether the caecal contents and caecal tissue might be altered, physiologically, by ligating the pancreatic ducts and thus present unsuitable conditions for the coccidial growth.

1. To clarify the problem, the infection of the ligated chickens was attempted using E. tenella merozoites collected from the caecal contents of some chicken destroyed on the 4th-5th day after infection, and introducing them at the portion of the entrance of the caecum into the intestine, rectally. The results obtained indicated that the caecal tissues of the ligated chickens supported the growth of coccidia, as in the case of the normal control, the alteration not being enough to reduce the possibility of infection because, even in this case, infection resulted with the appearance of oocysts in the fecal discharge of these chickens 2 days after the introduction of the merozoites.

2. On the basis of the hypothesis that the pancreatic juice acts on the excystation of the sporulated oocysts in the intestinal canal, all the feces passed by the ligated (pancreatic ducts) and control chickens were collected during the 2-6 hours following the introduction of the sporulated oocysts into the crops and the relative number of sporulated oocysts in each group of feces was estimated by comparing them

per gram of feces discharged by these chickens. It was estimated that the feces of the ligated chickens contained 19 times as many oocysts as those of the controls.

3. The experimental introductions of sporulated oocysts into chickens, both normal and with ligated pancreatic ducts, by unnatural routes (duodenum and caeca) were carried out to investigate the effects of the pancreatic juice on the infection. While the sporulated oocysts introduced into the duodenum of the ligated chickens produced no evidence of infection, although infection resulted in the normal chickens, positive results were obtained by introducing oocysts mixed with trypsin. In the case of the introduction of sporulated oocysts into the caeca of the normal and ligated chickens, none of them became infected, but the injection of oocysts suspension containing trypsin resulted in infection.

4. The investigations of the effects of heating trypsin or pancreatin solution in the case of E. tenella infection in chickens with ligated pancreatic ducts indicated that the decrease of the activity of those enzymes was considerably inhibitory to E. tenela infection in vivo.

Results described above indicated that the pancreatic juice was an essential factor for E.tenella infection, and the main site of the action should be the excystation of oocysts in the intestinal canal, and suggested that proteolytic enzymes in the pancreatic juice might be essential components for infection. In addition to the previous reports, that the upper intestinal canal other than the gizzard were not necessarily essential for infection, were also confirmed by this finding.

129. Clinical effects of selenium sulfide suspention for skin diseases in dogs and cats. Shin OKOSHI, Mampei USUI and Isamu TOMODA (Journ. Jap. Vet. Med. Ass. **9**, 583-584, 1956)

The treatments of skin diseases in dogs and cats are very difficult and effective skin remedies are very few.

The authors made clinical studies of nonspecific skin diseases in 19 dogs and 3 cats, treating with seleen (1% selenium sulfide suspension, ABBOTT), and appreciated the high effectiveness.

Seleen is brown-colored dense emulsion, has pleasant odor and strong cleansing action as a shampoo.

Application of seleen is as follows; wet hair with warm water, then apply seleen and work into skin of entire body, being careful around the scrotum and eyes, allow seleen to remain in contact with the skin for fifteen minutes, and rinse hair and skin with warm water.

Treatments were repeated at intervals of seven days and in severe skin conditions, three or four days.

In these clinical studies they found high healing percentage of nonparasitic eczema by treating with seleen.

130. A clinical evaluation of photosensitizing dye remedy, Temper L, against the so-called distemper complex. Shin OKOSHI, Isamu TOMODA and Mampei USUI (Journ. Jap. Vet. Med. Ass. **9**, 485-487, 1956)

The photosensitizing dye remedy, Temper L, was used in clinical evaluations on 22 cases of the diseases of the so-called distemper complex in dogs.

Temper L is the powder of Cyanin Complex and is dissolved in Vitamin B (10 mg/cc) or 5% glucose at a concentration of 1 mg/cc, while using. This was administrated at the rate of 0.5 mg/kg of body weight subcutaneously for a few days.

In several cases showing the symptoms of the so-called nervous form of distemper and hard pad disease, Temper L proved of no effect.

However, this drug had effects in cases showing the symptoms of so-called respiratory and gastro-intestinal form of distemper in dogs. As Temper L had no toxic action by daily administration of 0.5 mg/kg of body weight for a few days, it could be administrated freely even in severe cases when the patients are weak.

131. Studies on pasteurella pseudotuberculosis rodentium. Yuichi OCHI, Takayasu TAKIZAWA, Ryotaro ISHIZAKI and Shin-ichiro KONISHI (Jap. Journ. Vet. Sci. 18, 151–157, 1956)

In April, 1952, An epizootic occurred among guinea pigs bred in a certain place in Tokyo. Several strains of organisms, which seemed to be of the same species, were isolated from them. Some strains of these organisms were also isolated from other guinea pigs, sacrificed for some experiments in our laboratory, and from the liver of a goat.

In form, these organisms varied from coccoid to bacillary forms, generally appearing singly and occasionally in chains. Bipolar staining was sometimes seen. They were Gram-negative, non-acid-fast, not encapsulated and not spore-bearing. Motility was seen in young cultures grown at 22°C.

On plain agar, good growth occurred without the addition of serum or other enrichment. Blood agar showed no hemolysis. Growth in broth was fairly good. There was moderate turbidity in 24 hours at 37°C, but later the growth sedimented into a mass. A surface ring usually appeared. Litmus milk slowly became alkaline. Indol was not formed, but NH_3, catalase and urease were formed. Acid, but no gas was formed from salicin, levulose, mannitol, galactose, maltose and glucose. Sucrose, inulin, dulcitol and lactose were not attacked.

The disease was easily produced in mice, guinea pigs and rabbits, by inoculation. A caseous local lesion developed at the site of inoculation, the regional lymph nodes became enlarged and caseous, and sometimes nodules were found in the liver and spleen.

These organisms were identified with Pasteulla pseudotuberculosis rodentium because of the above mentioned characteristics.

These organisms were classified by the agglutination test into five types (Type I-V). Type V might be further divided into two sub-types. Each type showed strong type-specific reaction with the absoption test. It seemed that type IV possessed Salmonella 0-9 antigen.

Though, amongst organisms, there were no strains which had the Sal.0-4 antigen reported by other workers, it seemed that the organisms could be divided into at least more than 6 types and one type had Sal. 0-9 antigen and another one had 0-4. There were no relations between sources and types of these organisms, but

all the strains isolated from animals except rodents belonged to type IV. There were no overlapping reactions, serologically, between these organisms and some of the Enterobacteriaceae such as Salmonella except D group, E. coli (0-1-126), Proteus vulgaris and Proteus mirabilis.

As these organisms were similar to Enterobacteriaceae in some morphological and biological characteristics, and since certain strains among them had common antigen with Salmonella, some workers did not agree with the identification of these organisms with Pasteurella. But at present, we cannot identify these organisms with any other but Pasteurella.

132. Studies on infactious hepatitis of dogs. II. The distribution of the disease in Japan, and its immunization. Norimasa SASAKI, Takeji NAKAI, Ichizo IWAMOTO, Shin-ichiro KONISHI and Takeji IKEGAMI (Jap. Journ. Vet. Sci. 18, 113–118, 1956)

Previously, the authors were the first to isolate the infectious canine hepatitis virus (H.c.c. virus), D43 strain, and report that the disease existed in Japan. Thereafter, distribution of the disease and its immunization were studied, and the results obtained are as follows.

1. In various districts of Japan, 329 serums were collected from random street dogs, and the serological survey was made. Of these, 76 (23.4%) reacted positive to H.c.c. by the complement fixation test, but this frequency took a wide range between 0 and 38.5% in different districts. The high frequency of positive results showed that the disease was wide spread, but it also showed the distribution of this disease in Japan was either equal to, or lower than that in foreign countries.

2. In order to recognize the susceptibility of random street dogs to the "D43" strain virus of the disease, the authors made comparison of cases occurring in a district showing high frequency (Tokyo, 37.4%) with those occurring in one showing low frequency (Kyoto, 4.1%). The susceptibility of dogs in both districts showed a distinct difference in inverse proportion to the frequency of positive results shown by the complement fixation tests, i.e. morbidity was 67.7% and mortality was 41.8% in Tokyo, where as it was 94.1% and 76.5% in Kyoto.

3. A vaccine was made from 10% or 20% emulsions of saline of liver from a dog which had developed typical symptoms and died of the infectious hepatitis virus (D43 strain) infection. Formalin was added to the extent of 0.2% and the mixture was kept at 25°C for 10 days or more. In use, the vaccine was injected subcutaneously in the proportion of 3 or 5 cc, and 21 days later, 100,000 MLD of infectious hepatitis virus was inoculated to experimental dogs.

As to results, when given the vaccine made from 10% suspension of liver, the dogs developed some symptom and leucopenia, but when given the vaccine made from 20% suspension, the dogs showed elevated CF titre and no response.

4. Hyperimmune serums were obtained from dogs (convalescent or vaccinated) immunized by the repeated inoculation with a great volume of the virus.

The intravenous injection of serum, in the proportion of 2 or 4 cc per kg of body weight, protected dogs completely against 1,000 MLD of infectious hepatitis virus given immediately before the serum injection.

When experimental dogs developed infectious hepatitis after the injection of the virus, we injected a hyperimmune serum at the rate of 2 cc for kg of body weight.

One recovered rapidly, but another turned only temporarily to normal as to symptoms and leucocyte count, while it showed corneal opacity and bloody feces.

133. Studies on avian type tuberculosis. Part 9. Effect of sensitization on Yersin type tuberculosis in rabbits. (2). Shutaro YAMAMOTO, Kiichi ISHIDA, Akio SATO, and Reiji TAKAHASHI (Jap. Journ. Vet. Sci. 18, Suppl. 5, 1956)

The authors have made a series of reports concerning the effects of sensitization on the acute form of experimental avian tuberculosis in rabbits. In the previous studies they performed a serial observation of the rabbits, which had received subcutaneous injection of low virulent avian type tubercle bacilli, 3 weeks before they were reinoculated with high virulent avian type tubercle bacilli. It was found that in the reinoculated animals with the same dosage of the bacilli, by which the Yersin type tuberculosis should be produced, the lesions similar to those of Villemin type appeared in a relatively short period by the reduction of liver lesions and gradual development of the pulmonary lesions, and that the growth of bacilli in the liver, spleen and bone marrow of reinoculated rabbits had been markedly inhibited; on the other hand in the lung and kidney, such a phenomenon had not been observed. They concluded that the effects of sensitization differ greatly according to the organs.

The study reported here was performed on the expectation that, when the period of the sensitization was prolonged, the effects of it might be equalized among those two types of organs.

Two groups of rabbits had received subcutaneous injection of a low virulent avian tubercle bacilli 10 and 25 weeks respectively before they were reinoculated with high virulent avian tubercle bacilli. Reinoculation was made at the same time to both groups with doses of 0.1 mg per kilo. of the body weight. Another 5 normal rabbits were also inoculated with the same dosage of high virulent avian tubercle bacilli. Animals which died or sacrificed until 24 days after reinoculation were examined by means of histopathological observations of various organs and by the quantitative culture of liver, spleen, kidney, lung, adrenal, bone marrow and lymph node. Results were as follows:

(1) On the growth of bacilli of 10 weeks group, strong inhibition was noted in the liver, spleen and bone marrow, and even in the lung where no effects were recognized in the previous study. On the contrary, the growth of bacilli in the kidney could not be inhibited to the end of the observation, as had been observed in the previous studies. In some cases of the 25 weeks group, far more bacilli could be demonstrated than in cases of the 10 weeks group even in the histopathological observations. They showed weaker reaction than 10 weeks group, following intradermal injection of tuberculin, at the time of reinoculation.

(2) In both groups of sensitized animals, the lesions appeared earlier and were more localized than in the Yersin type. But in the 25 weeks group, lesions appeared a little later than the 10 weeks group. Moreover, the reduction of lesions in the liver and spleen which had been observed in the previous study was also observed in a case of 10 weeks group, but others showed no reduction of the lesions.

As conclusion, the effect of sensitization in the 10 weeks group were almost similar to that of the 3 weeks group which had been reported previously, but in the 25 weeks group the effects of sensitization in the R.E.S. organs seemed to have been somewhat reduced.